“SCREENING FOR ‘AT RISK’ UNDER FIVE CHILDREN BY COMMUNITY HEALTH WORKERS – A STUDY IN A RURAL AREA OF TAMIL NADU”

DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT OF THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY, CHENNAI, FOR THE DEGREE OF MD BRANCH XV (COMMUNITY MEDICINE) EXAMINATION TO BE HELD IN MAY 2018

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CHENNAI

MAY 2018

CERTIFICATE

This is to certify that "Screening for 'at risk' under five children by health workers in a rural area of Tamil Nadu" is a bona fide work of Dr. Swathi Krishna N in partial fulfillment of the requirements for the M.D Community Medicine examination (Branch-XV) of the Tamil Nadu Dr. M.G.R. Medical University, Chennai, to be held in May 2018.

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This is to certify that this dissertation titled "SCREENING FOR 'AT RISK' UNDER FIVE CHILDREN BY COMMUNITY HEALTH WORKERS - A STUDY IN A RURAL AREA OF TAMILNADU" is a bonafide work done by me, under the guidance of DR. VINOD JOSEPH ABRAHAM and DR. ANURADHA BOSE, in partial fulfilment of the rules and regulations for the MD Branch XV (Community Medicine) Degree examination of the Tamil Nadu Dr. M.G.R. Medical University, Chennai, to be held in May 2018.

I have independently reviewed the literature, collected the data and carried out the evaluation towards the completion of the thesis.

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ABBREVIATIONS

ASHA	Accredited Social Health Activist
CHAD	Community Health And Development
CHD	Congenital Heart Disease
CHW	Community Health Worker
CNS	Central Nervous System
DALYs	Disability Adjusted Life Years
DLFHS	District Level Facility and Household Survey
ELBW	Extremely Low Birth Weight
FAO	Food and Agriculture Organisation
GHO	Global Health Observatory
IMR	Infant Mortality Rate
MDGs	Millennium Development Goals
MGRS	Multicentre Growth Reference Study
MNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
NFHS	National Family Health Survey
NPV	Negative Productive Value
NRHM	National Rural Health Mission
LBW	Low Birth Weight
PPV	Positive Predictive Value
SD	Standard Deviation
SDGs	Sustainable Development Goals
SPSS	Statistical Package for the Social Sciences
UN	United Nations
U5MR	Under 5 Mortality Rate
WHO	World Health Organization

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1 INTRODUCTION AND JUSTIFICATION

The initial few years of life are quite crucial in the survival of a child as the child is vulnerable to various risk factors leading to disease, disability & death during this period. Globally, around 5.6 million children below the age 5 yrs died in the year 2016 (1). The Millennium Development Goals (MDGs) by the United Nations (UN) had set the goal of reducing child mortality by the year 2015 and three indicators of infant mortality rate (IMR), under five mortality rate (U5MR) and measles immunization were used for this (2).As per the National Family Health Survey 2015-16 (NFHS-4), the infant mortality rate of India was 41 per 1000 live births and under five mortality was 50 per 1000 live births and for Tamil Nadu these were 21 and 27 per 1000 live births, respectively (3), (4).The new Sustainable Development Goals (SDGs) adopted by the UN to be achieved by the year 2030 also aims at reducing child mortality and India is in the pathway of achieving it.

However, in a middle income country like India where the large population is a bottleneck to providing equal attention to all the categories, intelligent allocation of resources needs to be done whereby more attention is given to the population 'at risk'. This is the juncture at which 'risk approach' assumes importance as a managerial tool in healthcare system. World Health Organisation has put down certain guidelines for strategies feasible in maternal and child healthcare system in developing nations under the title of 'Risk Approach for Maternal and Child Healthcare' (5).

India has a good primary healthcare system consisting of grass root level community health workers which enables to utilise available human resources for effective

rendering of services without burdening the healthcare system. Tamil Nadu, in particular, is leading in its public health activities owing to the good network of health workers. However, more studies need to be done to quantify the prevalence of various risk factors among the under five age group.

This study was carried out to determine the prevalence of ‘at risk under five children’ using a screening process by health workers in the community.

2 OBJECTIVES

- To screen for ‘at risk’ under five children in a rural area of Tamil Nadu using community health workers during the period October 2016 to June 2017

- To validate the screening done by the community health workers

- To determine the prevalence of ‘at risk’ under five children’ in this population based on the screening and validation

3 LITERATURE REVIEW

3.1 Importance of under five age group of children

The age group of children from birth to 4 years, commonly termed as the 'under five' children, constitutes a considerable proportion of World population – about 6,73,649 (9.1%) according to statistics of the year 2015 (6).

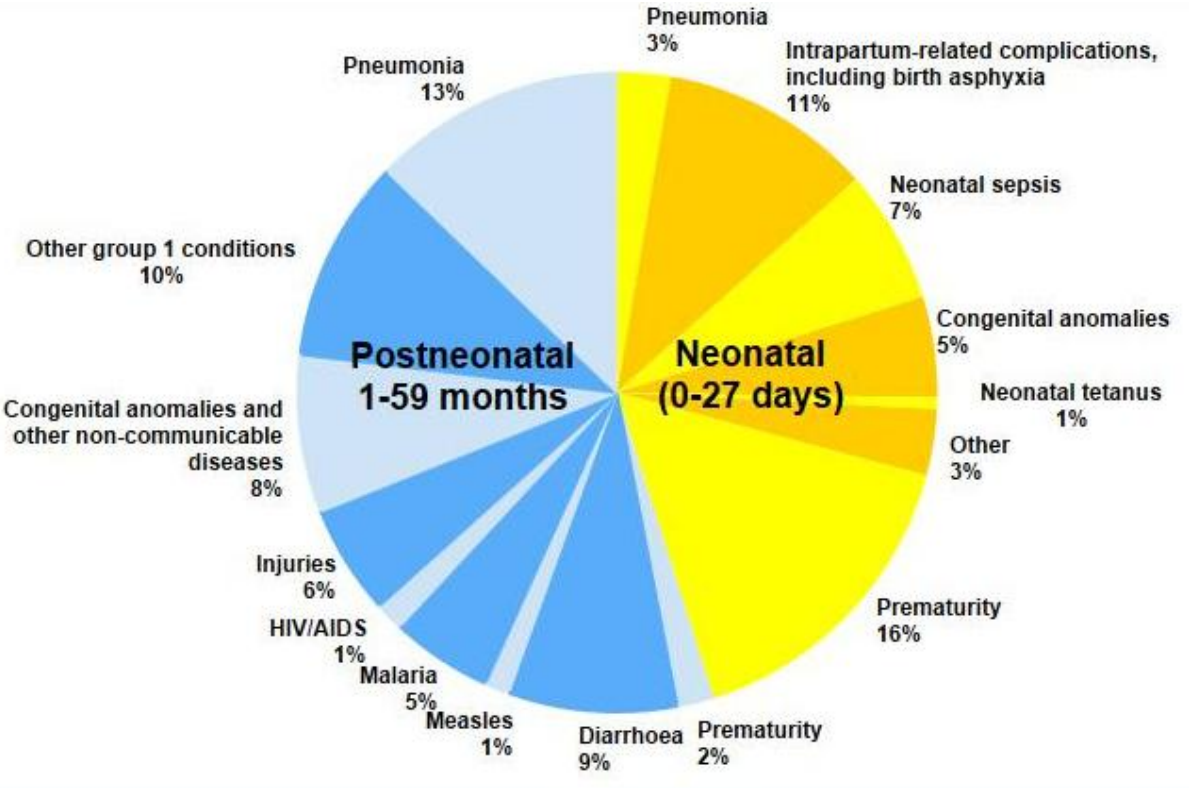
According to 2011 census in India, children under the age of 5 years constituted 9.7% of India's total population (7). This age group of children is important as they are highly vulnerable to various risk factors medically as well as socially and they are the future generation of a nation providing human resources for the growth and development of the country in long run.

Under 5 mortality rate, with the proportion of newborn deaths, is one among the 11 key indicators for maternal, newborn and child health as prescribed by the World Health Organisation (8). The Infant Mortality Rate (IMR) of India during 2015-16 period is 41 per 1000 live births and under five mortality rate (U5MR) is 50 per 1000 live births (3).

The Global Health Observatory (GHO) data by the World Health Organisation (WHO) states that 5.9 million under five children died in 2015 in the World. In India, the major reasons for under five deaths are prematurity (27.5%), acute respiratory infections (14.9%), birth asphyxia/ trauma (11.5%), acute diarrhoeal diseases (9.8%), congenital anomalies (9%), sepsis/other infections in newborns (7.9%) etc. (9). Children are exposed to maximum amount of risk factors during this period. These

figures emphasise why the age group is important and why healthcare providers should intervene for early detection and prevention of further morbidity and mortality.

Figure 1. Causes of death among children under 5 years



[Source: WHO Global Health Observatory Data**(9)**]

3.2 Maternal and Child Health in Low Resource Settings

The World Bank data classifies countries across the globe into income groups. Countries like Singapore, USA, Germany and Ireland belong to the 'high income' group; Brazil, Iran, Iraq and Libya to the 'upper middle income' group; India, Indonesia, Bangladesh and Pakistan to the 'lower middle income' group; Afghanistan, Ethiopia, Haiti and Nepal belong to the 'low income' group (10).

Resources include personnel- both trained and trainable, facilities and equipments including infrastructure, organisational efficiency or capability which includes the ability of the manager to organise services and supplies effectively along with supervision, maintaining discipline and facilitating referral when necessary and a proper health information system which would monitor health of the population served, utilisation of healthcare services and effectiveness of interventions (5).

The United Nations Millennium Declaration of 2000 was signed by the UN member nations to combat poverty, hunger, disease, illiteracy, environmental degradation, and discrimination against women. It states the 8 Millennium Development Goals (MDGs) which were to be achieved by 2015 - to eradicate extreme poverty and hunger, to achieve universal primary education, to promote gender equality and empower women, to reduce child mortality, to improve maternal health, to combat HIV/AIDS, malaria, and other diseases, to ensure environmental sustainability and to develop a global partnership for development (11).

Maternal and child health is one of the key areas of healthcare requiring proper channelizing of resources for effective delivery and utilisation of services. Maternal Mortality Ratio (MMR), Infant Mortality Rate (IMR), under five mortality rate (U5MR) are some of the indicators of MDGs which gives an idea about the progress of a nation and help in planning and implementation of health policies and programmes.

3.2.1 Challenges in Low Resource Settings

Low resource settings face huge constraints in terms of money, material and human power. Some of the challenges faced include financial inaccessibility in terms of inability to pay and informal fees, physical inaccessibility in terms of distance to healthcare facility, poorly motivated or inappropriately skilled staff, weak planning and management, lack of intersectoral action and partnership and poor quality of care by private sector providers. Intervention- specific approaches are taken for various global initiatives and national health programmes in the already existing broad healthcare system, which helps in overcoming the system constraints. But this parallel system can also result in duplications- parallel system for programme – specific drug delivery can increase transportation costs, increase in number of forms to be filled by health workers for drug procurement etc., distortions- highly paid special cadre of staff for one particular programme may deplete/demotivate staff from other key functions, disruptions- special training programmes may take away effective working hours/days and distractions- specific, uncoordinated reporting requirements takes away productive time. Careful planning and execution of health policies and programmes must be done to deal with these problems (12).

3.3 Long Term Effects on Healthcare System

The large number of children ‘at risk’ has serious implications in terms of effects on the country’s healthcare system.

3.3.1 Burden on Healthcare Providers

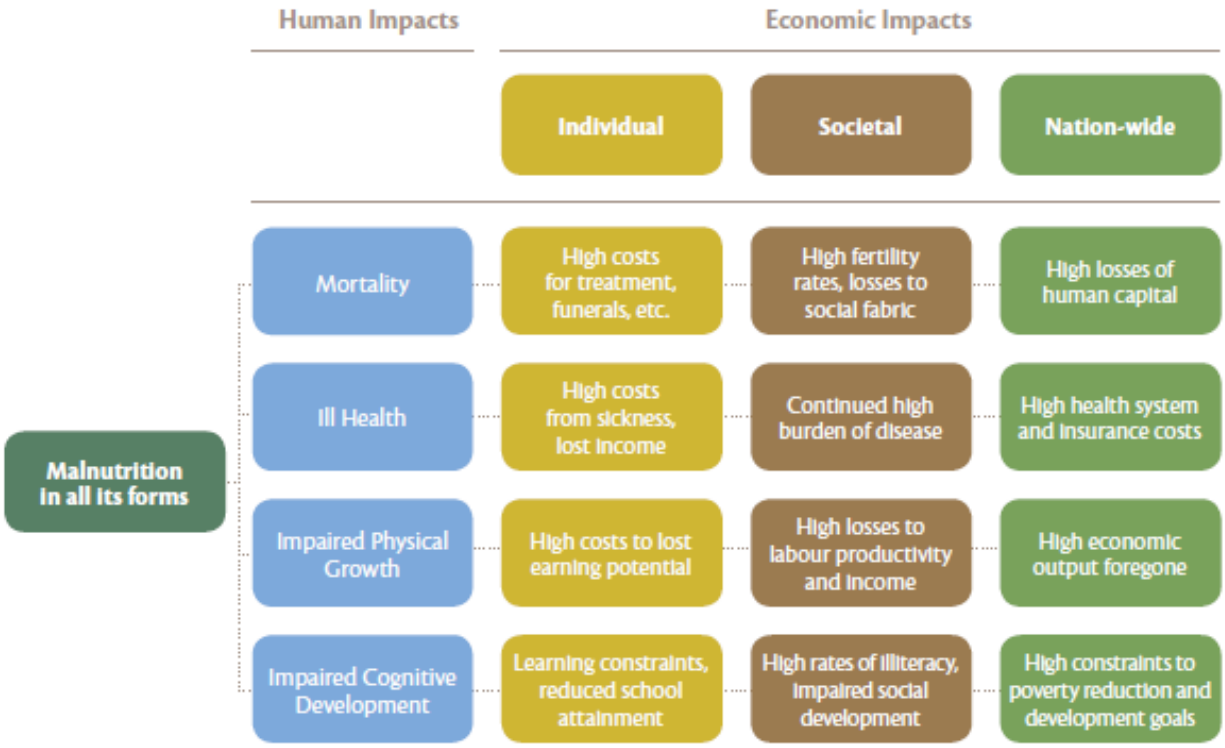
Policy makers and healthcare providers face serious challenges in low and middle income countries when it comes to planning and implementation and allocation of resources to meet the growing needs due to high prevalence of ‘at risk’ population of children. Early detection of children ‘at risk’ and initiating early interventions will substantially reduce the costs likely to incur in treating the morbidity or the likely loss due to mortality. For example, in the Global Health Risk Report released by WHO in 2004 it is mentioned that underweight and suboptimal breastfeeding were the top reasons for an estimated 3.9 million deaths and 144 million DALYs (Disability Adjusted Life Years) among under five children. It also mentions that in low income countries, easy-to-remedy nutritional deficiencies account for deaths of 1 in 38 newborns(13).

Malnutrition, especially underweight, stunting and wasting, is one among the top risk factors among under five children. According to a report in 2016 on impact of childhood malnutrition by Food and Agriculture Organisation (FAO), the cost of childhood malnutrition in terms of healthcare expenditures can be private or individual costs borne by the individual/family and public costs borne by the government or other institutional costs. The larger cost is to the family due to the healthcare expenditure involved and loss of income due to morbidity/mortality (14).

3.3.2 Impact on Economy

The impact on economy due to children 'at risk' is tremendous. Taking the example of malnutrition again, we find that its present as not only the individual economic impact, but on a societal and nationwide basis also.

Figure 2. Conceptual framework for understanding the economic effects of malnutrition



[Source: Cost of Malnutrition by Global Panel on Agriculture and Food Systems for Nutrition 2016(14)]

About 45% of all child deaths are due to undernutrition. Severely undernourished children have 9 times the risk of mortality than well nourished children. This preventable cause of mortality leads to human capital loss. Treatment costs account to yet another huge proportion of expenditure. Sub optimal physical growth due to undernutrition along with lifelong increased susceptibility to illnesses will reduce the

economic productivity. Impaired cognitive development leads to poor scholastic performance (14).

3.4 Risk factors in children under 5 years age

The age group under 5 years being most vulnerable to all injuries and insults calls for special attention from the part of caregivers and health providers. ‘Risk factor’ is any ascertainable characteristic or circumstance of a person/ group of persons that is known to be associated with an abnormal risk of having, developing or being adversely affected by a morbid process. The risk factors not only include medical or surgical factors, but also certain social and cultural factors which can put the children ‘at risk’ for developing diseases. In India, about 1.7 million under five deaths occur which contributes to 28% of the total global burden (5).

Based on various studies conducted across the globe, the WHO had come up with a list of risk factors for children in this age group. Risk strategy is a managerial tool for organisation of healthcare with an intention to provide better services for all, but special attention to those who need them the most (5).

3.4.1 Socio-cultural Factors

3.4.1.1 Maternal Education

Maternal education has been found to have considerable influence on various child rearing practices. Mother being the primary caregiver, especially in the Indian social setting , has important role in childcare including feeding practices, immunisation, growth monitoring, healthcare seeking for common childhood illnesses like acute

respiratory infections and acute diarrhoeal diseases, identifying developmental delay at an early stage etc.

In a study conducted in Nairobi, Kenya it was found out that maternal education has a significant effect on child growth. The odds of child stunting are 29 % higher for mothers with no education or lower than secondary education, relative to mothers that have at least secondary education (5).

Ripon Kumar Mondal et al conducted a study in Bangladesh in 2014 which revealed that maternal education critically correlated with long term health outcomes of the child. Maternal education was specifically shown to have a significant positive impact on child's height for age Z-scores (15).

In another study conducted by P Govindasamy& B M Ramesh using the National Family Health Survey of India – 1992-93 data, maternal education was also found to be beneficial in terms of health care seeking for their children. Regarding those who sought treatment for their children aged below 4 years for acute respiratory infection, about 80% of mothers with education of middle school and above had healthcare seeking behaviour whereas only 65% of illiterate mothers sought treatment for their child. Regarding treatment seeking for diarrhoeal diseases, only 60% of illiterate mothers sought treatment for child whereas 70% of mothers with education of middle school and above sought treatment for their child. Immunisation is another area getting impacted by maternal education. About 65.6% of mothers with middle school education and above vaccinated their child whereas only 24% of illiterate mothers did so (16).

Another study conducted among 405 mothers with under five children byChandwani and Pandor in Narmada district of Gujarat found that out of the 98 illiterate mothers, 24.5% had healthcare seeking behaviour for their children and among 307 literate mothers, 78.3% had healthcare seeking behaviour. This association was statistically significant with a p-value of <0.05 and Chi- square value of 60.76 (17).

3.4.1.2 Socioeconomic Status

The relationship between childhood health and family income is called child health-income gradient. It is used to explain the disparities between the health statuses of children from wealthier and poorer families. In a study conducted by Case et al in the United States of America during the year 2002, it was found that family income is a strong determinant of childhood health status (18).

Kanjilal et al studied the National Family Health Survey-3 (NFHS-3) data and found that nearly 50% better nutritional status were among children from richest SES quintiles than the poorest quintiles (19).

Better socioeconomic status leads to improved maternal education and hence improved child rearing practices including healthcare seeking behaviour for common childhood illnesses, good immunisation status, adequate nutrition etc. The analysis done by Goli et al on the NFHS-3 data regarding the pathways of economic inequalities in maternal and child healthcare in urban India revealed that the proportion of underweight children was 61% and child without complete immunisation was 73% in the poorest wealth quintile whereas these proportions were 26% and 28% respectively in the richest wealth quintile (20).

Various scales are in use for measuring socioeconomic status. The modified B G Prasad scale is one which is widely used in India. It is based on monthly income per capita of the family, first proposed in 1960, latest modification being in 2017(21).

The Pareek classification is used in rural areas and is based on caste, occupation, education, level of social participation of head of the family, landholding, housing, farm power, material possession and total members in the family (22).

The modified Kuppuswamy scale is used to measure socioeconomic status in urban areas and uses education, occupation of head of family and income per month from all sources as parameters (21). A conversion factor calculated based on current All India Consumer Price Index (AICPI) is applied to get current income group.

In the National Family Health Survey – 2 (NFHS-2) conducted by the Government of India, the Standard of Living Index (SLI) was used which had taken into account 11 parameters- house type, source of lighting, toilet facility, main fuel for cooking, source of drinking water, separate room for cooking, ownership of the house, ownership of agricultural land, ownership of irrigated land, ownership of livestock, ownership of durable goods for measuring the SES both urban and rural areas for the entire country (23).

3.4.1.3 Birth Order of the Child

The birth order of the child is shown to have obvious effect on growth parameters like height. In a retrospective cohort study conducted by Myrskyla et al among 6, 52, 518 Swedish men, increase in birth order was associated with decrease in height. The first and second born were equally tall whereas height decreased for further birth orders- birth orders 3, 4, 5 and 6+ were associated with 0.2, 0.7, 1.1 and 1.8 cm ($p<0.001$ for each) decreased height (24).

Lundberg and Svaleryd did a retrospective cohort study among Swedish children and found that later born siblings are more likely to be hospitalised for injuries and many avoidable conditions, which could be attributed to reduced parental attention for the children with higher birth order (25).

The analysis of NFHS 1, 2, 3 data by Jayachandran and Pande showed that the height disadvantage for Indian under five children opens up at birth order 2 and further increases steeply with birth order 3 and above - height- for – age Z- score gap of -0.28 as compared to African children (26).

In an analysis done by Bhanu Gupta on the Annual Status of Education Report – 2014 data (ASER-2014) done in all rural districts of India, the second and later born children had disadvantage in terms of learning outcomes as compared to the first born (27).

3.4.1.4 Death of Either or Both Parents

Death of father, mother or both impacts various domains of the child's life adversely like growth, psychosocial development including interpersonal relationships and substance abuse, incidence of various diseases, education etc. The effects of death of mother are more pronounced as compared to that of father's death- the infant that is left behind has 2 to 50 times more risk of death. A cohort study conducted by Ronsmans et al in rural Bangladesh showed that the cumulative probability of survival to 10 years age was 89% among the children whose mothers remained alive whereas it was only 24% in children whose mothers died before their tenth birthday. The highest effect was among children aged 2 to 5 months (rate ratio 25.05, 95% CI 18.57-33.81) which could be mainly attributed to the abrupt cessation of breastfeeding for these children (28).

In a study on risk factors for child survival done by Sartorius et al in rural South Africa, death of father either before birth of the child or during the first 4 years of child's life led to significant child mortality with a relative risk of 2.41 (95% CI 1.53-3.82) (29).

3.4.1.5 Mother Working Outside

Mother's employment is shown to have advantages as well as disadvantages on child health. The advantage of better income to provide improved facilities for the child, better healthcare seeking due to increased maternal knowledge and awareness about diseases, improved nutrition due to increased income and enhanced self care capabilities of the child due to less dependence on mothers have been well explained

in various studies. However a deprivation of maternal care during the initial crucial period of a child's life along with work related maternal stress and mediocre care given by alternative caregiver have been found to be detrimental to child health. Analysing the data from NIHCD study on Early Childcare in the USA by Brooks-Gunn, Han and Waldfogel, it was shown that full time maternal employment in the first 12 months of the child's life was associated with significantly lower scores on some cognitive development measurements at ages 3 and 4 ½ years age group of children (30).

A study conducted by Abbi et al in rural Maharashtra, India showed that the relative risk of the children of working mothers being malnourished was 1.7 in terms of weight for age and 1.8 in terms of height for age as compared to children of non working mothers (31).

3.4.2 Medical and Surgical Factors

3.4.2.1 Prematurity/Preterm Birth

A gestational age of 37 completed weeks is called 'term pregnancy' and everything lower than that is 'preterm'. However studies have shown that less than 32 weeks is the most affected group among preterm children. WHO statistics show that globally, 15 million babies are born preterm every year. Preterm birth complications contribute substantially to under five mortality across the globe, the number of deaths being 1 million in the year 2015 (32).

Prematurity is graded as extremely preterm (<28 weeks of gestation), very preterm (28 to <32 weeks) and moderate to late preterm (32 to <37 weeks). Survivors of neonatal period are highly prone for lifelong disabilities like learning disabilities, visual and hearing problems. In most of the low income countries, about half of the babies born at or below 32 weeks die due to a lack of feasible, cost-effective care, such as warmth, breastfeeding support, and basic care for infections and breathing difficulties (32).

Schneider et al examined visual motor skills as an indicator of fine motor skills among children aged 8 years who were born prematurely. There were significant differences in fine motor skills in between children who were born at 26 weeks and 31 weeks (33).

D'angio et al did a 15 year long follow up study on children born prematurely and looked into their school performance and cognitive skills. They found out that intraventricular haemorrhage in the neonatal period is a strong predictor of adverse outcomes in preterm children in terms of school performance and cognitive skills (34).

A nationwide mortality survey conducted by The Registrar General of India in collaboration with the Million Deaths Study in 2001-03 revealed that out of 1.01 million neonatal deaths that occurred, 0.33 million were due to prematurity and low birth weight (35).

WHO's guidelines for maternal and child health has key interventions which focuses on preventing preterm births which include counselling on healthy diet and proper nutrition, and tobacco and substance use, foetal measurements including use of ultrasound to help determine gestational age and detect multiple pregnancies, a

minimum of 8 contacts with healthcare professionals throughout pregnancy to identify and manage other risk factors, such as infections, better access to contraceptives and increased empowerment (32).

3.4.2.2 Death of one or more siblings below 1 year age

The death of a child during neonatal period or infancy has implications on the subsequent pregnancies and children. The WHO puts previous infant loss as a risk factor in terms of maternal and child healthcare (5). A research conducted in University of South Florida and University of Rochester concluded that out of the 3,20,350 women studied, women with prior infant death were 3 times more likely to experience stillbirth in their subsequent pregnancy (36).

Maria Powell did a study in Irish community and found out that the subsequent child will experience the vulnerable child syndrome wherein the parents are overprotective about the child. The emotional trauma to the child due to loss of a sibling is also quite significant (37).

3.4.2.3 Twin Birth

Twin gestation is a well known risk factor for adverse child outcomes. In a multicentre retrospective cohort study conducted by Hack et al in Netherlands, 465 monochorionic twins without twin-to-twin transfusion syndrome were studied, in which after 32 weeks of gestation, 5 out of 930 foetuses died in utero and there were 6 neonatal deaths. In women who delivered at term, the perinatal mortality rate was 7

per 1000 infants. The babies born also experienced respiratory problems owing to lung immaturity (38).

A cohort study done by Pharoah et al showed that following the death of one twin, the surviving co-twin was at higher risk of cerebral impairment, about 20% (95% CI 16-25) (39). Another study by Glinianaiah et al also showed that the prevalence of cerebral palsy among surviving co-twin was 93 per 1000 infant survivors and overall neurodevelopmental delay prevalence was 175 per 1000 (40).

Williams et al found that low birth weight, low gestational age and being one among the twins were all independent risk factors for developing cerebral palsy, with a crude rate of 7.4 per 1000 survivors at 1 year (41).

Twins are also at increased risk of various genetically inherited morbidities in future life as they share several familial characteristics. Cohort study done by Ahlbom et al concluded that the risk of colon, rectum, prostate, breast and cervical cancers among monozygotic twins who had more genetic similarity than dizygotic twins (42).

3.4.2.4 Low Birth Weight

WHO defines low birth weight (LBW) as a birth weight of less than 2500 grams. It is subdivided into very low birth weight (VLBW- less than 1500 grams) and extremely low birth weight (ELBW- less than 1000 grams) (43).

LBW babies are more prone for neonatal infections, respiratory distress owing to associated prematurity, delayed growth parameters, increased risk of metabolic and cardiovascular disorders later in life.

A prospective cohort study by Hack et al in Ohio, USA found that VLBW females catch up growth by 20 years of age but VLBW males remained shorter and of less weight than their normal birth weight counterparts. Catch up growth has significant effects on cardiovascular and metabolic risks in later life, so these findings were important (38).

Roy et al conducted a study in India among preterm, low birth weight babies, both of which were independent risk factors for neonatal septicaemia. They found out that preterm or low birth weight males had higher chances of developing neonatal septicaemia than their female counterparts (44).

3.4.2.5 Weight for Age

The WHO Multicentre Growth Reference Study (MGRS) to determine child growth standards was conducted from 1997 to 2003 among children of various countries with varied ethnic backgrounds which included Brazil, Ghana, India, Norway, Oman and the USA. Weight for age is one among the 12 indicators prescribed which is a simple indicator helping to understand whether the child's growth is in the right track or not (45).

WHO provides charts for weight-for-age Z-scores for under five children, according to which weight- for- age for each age group can be classified. Mild malnutrition is weight-for-age Z- score less than -1 standard deviation (SD), below -2 SD is moderate malnutrition and below -3 SD is severe malnutrition.

An ideal model for measuring childhood malnourishment is one including height-for-age, weight-for-height and weight-for-age which measures stunting, wasting and

underweight, respectively. Gupta and Borkotoky analysed the NFHS-3 data and made some interesting observations regarding these indicators. They found that underweight was associated with both stunting and wasting but stunting and wasting was not related to each other. This indicated that stunting was not necessarily a predictor for wasting but for those children who had stunting in their early childhood; it would be difficult to improve in late childhood. The findings on the association of stunting, wasting, and underweight were consistent with the findings from past research (46).

As described by Patwari, Kumar and Beard using the NFHS-3 data, undernutrition among infants less than 6 months of age is an underestimated public health problem in India. 30% infants less than 6 months age were underweight, however only 28% of the exclusively breastfed infants were underweight whereas 31% of non exclusively breastfed infants were underweight (47).

3.4.2.6 Frequency of Hospital Admissions

Globally, the major reasons for under five mortality include prematurity, birth asphyxia, acute respiratory infections, acute diarrhoeal diseases and malaria. Emerging concerns include injuries, congenital anomalies and non communicable diseases. Children who fall ill and requiring frequent hospital admissions are always at risk (48). History of one or more hospital admissions in past one year among the under five children has been stated as a risk factor by WHO (5).

W B Douglas reported in 1975 that one admission to hospital of more than a week's duration or repeated admissions before the age of five years (in particular between six

months and four years) are associated with an increased risk of behaviour disturbance and poor reading in adolescence (49).

3.4.2.7 Congenital Heart Disease

Congenital heart diseases/defects are due to defects in the structure of heart at birth. Some of the congenital heart diseases (CHDs) are atrial septal defect (ASD), ventricular septal defect (VSD), patent ductus arteriosus (PDA), valvular heart lesions and complex CHDs like tetralogy of Fallot (TOF). Mortality due to CHDs has come down drastically due to improved medical technology. But early screening and detection play an important role in achieving this. Gilboa et al studied the mortality among children and adults due to CHDs in the USA during 1999 to 2006 and found that infant mortality constituted 48.1% of all mortality resulting from CHD; among those who survived the first year of life, 76.1% of deaths occurred during adulthood (≥18 years of age) (50).

In a review article on global burden of CHDs by Julien Hoffman, it is mentioned that though the incidence of CHDs is similar across the globe, the burden of supporting these patients falls heavily on countries with high fertility rate. Improving local health services and controlling infectious diseases (diarrhoeal illness, rheumatic fever, measles, rotaviral infection) are some of the supporting activities needed to reduce this burden (51).

Neurodevelopmental delay due to cerebral hypo perfusion is also implicated as a long term effect of CHD on child health (52).

In a population based survey conducted by Bhardwaj et al in rural Himachal Pradesh, the prevalence of CHDs in general population was found to be 6.3 per 1000 and atrial septal defect was the commonest lesion (53).

3.4.2.8 Central Nervous System Infections

Infection of central nervous system (CNS) can be that of meninges (meningitis) or brain matter (encephalitis). Bacterial meningitis caused by Neisseria meningitides (Meningococci), Streptococcus pneumonia and Haemophilus influenzae contribute substantially to under five mortality. An estimated 1.2 million deaths occur every year globally due to bacterial meningitis. Untreated cases can have a case fatality rate as high as 70% and one in five survivors are left with permanent sequelae like hearing loss, neurological disability or limb loss (54).

Fowler et al studied the long term effects of childhood encephalitis among children in the USA. They found that children suffered serious sequelae like personality changes, cognitive problems and epilepsy (55).

An observational study by Kumar et al in Uttar Pradesh, India showed Japanese Encephalitis caused by a mosquito borne Flavivirus to be one of the major causes of acute encephalitis syndrome in children aged 6 months to 12 years (56). There are many areas in India which are endemic to Japanese Encephalitis – around 86 districts across the country as per the National Vector Borne Disease Control Programme, which includes some areas in Tamil Nadu also (57).

3.4.2.9 Seizure Disorder

Seizures occur due to uncontrolled electrical activity of brain and seizure disorders/epilepsy can be due to hereditary conditions, birth defects, environmental factors, sequelae of CNS infections, head trauma etc. A review by Amudhan, Gururaj and Satishchandra states that India homes 12 million people out of the 70 million people living with epilepsy across the globe, around one sixth of the total burden of the disease (58), (59).

A study by Udani says that the prevalence of paediatric seizure disorder in India is similar to that of high income countries and neurocysticercosis tops the list of causes (60).

In a case control study done by Attumalil et al on risk factors of childhood epilepsy in Kerala, India among children aged 1 to 12 years with epilepsy, it was found out that family history of epilepsy, prolonged labour, cyanosis at birth, delayed cry after birth, presence of congenital malformations, admission to newborn intensive care unit, neurocutaneous markers, incessant cry in the first week, delayed developmental milestones, meningitis, encephalitis, and head trauma were found to be significant (61).

Another study by Datta et al in Vellore, Tamil Nadu, India showed that among the children and adolescents with seizure disorder, 53.8% children had significant psychopathology. The study also stated that belonging to a higher income group and living in an urban area (OR: 7.61, 95% CI: 2.78—20.8, p= 0.0001), having longer than 3 years of illness (OR: 2.39, 95% CI: 2.18—5.67, p= 0.03) and being treated by

more than one anti-epileptic drug (OR: 3.08, 95% CI: 1.09—8.72, p= 0.03) independently predicted psychopathology (62), (63).

3.4.2.10 Developmental Delay

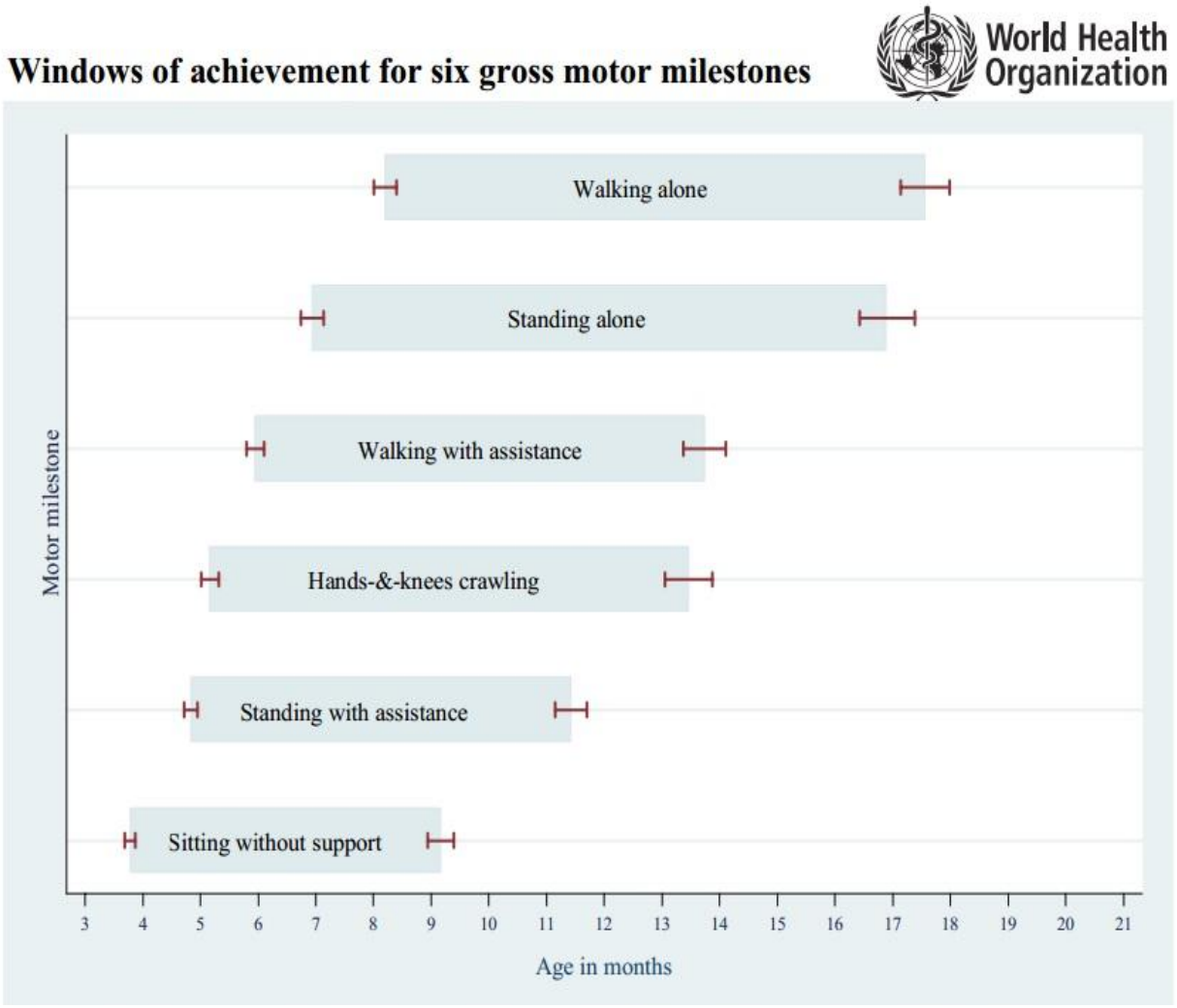
A child is said to have developmental delay if the gross motor, speech or language milestones are not attained appropriate to age. According to WHO Global Burden of Disease 2004 update, the prevalence of moderate to severe disability among children aged 14 years and below was about 9% (64).

A cross sectional study conducted by Nair et al in Kerala, India states the prevalence of developmental delay among children below 2 years as 2.31% (65).

Various scales are available to screen the children for developmental delay. Those used worldwide are multi-domain screening instruments like Ages and Stages Questionnaire (ASQ), Child Development Inventories (CDI), Kent Inventory of Developmental Skills (KIDS) which can be filled by parents or primary caregivers; Bayley Infant Neurodevelopmental Screener (BINS), Denver Developmental Screening Test (DDST), Infant-Toddler Developmental Assessment etc. which are to be filled by professionals (66).

The WHO Multicentre Growth Reference Study (MGRS) group gave the 'Windows of Achievement of 6 Gross Motor Milestones' chart which could be used easily at the community level to screen for developmental delay among children (67).

Figure 3. WHO – Gross Motor Milestones



[Source: WHO Multicentre Growth Reference Study Group, WHO Motor Development Study: Windows of achievement for six gross motor development milestones **(67)**]

An indigenous screening tool named the 'Trivandrum Developmental Screening Chart' or the 'Trivandrum Scale' developed by Nair et al from Kerala, India is also widely in use. It has a sensitivity of 66.8% and a specificity of 78.8% as tested against DDST as the gold standard (68).

3.4.2.11 Major Surgery

Common paediatric surgeries include repair of congenital heart defects, congenital diaphragmatic hernia, congenital hip dislocation, cleft lip/palate, congenital talipes equinovarus etc. Children usually suffer considerable morbidity and mortality after surgical procedures including anaesthesia complications. Mirzaei et al studied the postoperative complications among children operated for correction of congenital heart defects and found that 3% had renal complications, 3% had pulmonary complications, 4% vascular complications, 9% anaemia and 2% cerebral complications (69).

3.5 Risk Approach towards Maternal and Child Health by WHO

Despite health being one of the top priorities of any population, there has been an inequity worldwide in terms of resource allocation, accessibility/availability of healthcare services and its utilisation. There are small sections of people to which high quality healthcare services are available. Universal coverage is limited by lack of money and trained human resources in many countries. We should find ways to overcome these inequities with the limited resources available in order to benefit the majority of population, especially by using the primary healthcare approach (5).

3.5.1 Risk Approach and its Importance

Risk approach is a managerial tool in organising healthcare services, especially for vulnerable groups like mothers and children. The approach intends to provide care and attention to those in greatest need within the framework of healthcare for all. The ‘at risk’ individuals have a higher propensity to develop disease and its complications and the ‘risk approach’ should identify such individuals early and initiate timely interventions to reduce complications (5).

Preventive and promotive measures of health are of utmost importance in case of children as they are the future generation and long term effects matter. The ‘risk approach’ enables a system to prioritise their targets, measure associations between risk factors and outcomes and plan interventions in such a way that it makes best use of the measurements within the existing cultures and formal and informal healthcare facilities in that particular society (70).

3.5.2 Relevance in Indian Setting

India is a land of diversities, with varied cultures. Implementation of healthcare strategies has to be region specific, taking into consideration the unique problems and social setup of that particular region. Primary healthcare system plays an important role in delivery of services, especially to the vulnerable group including mothers and children. There are huge disparities among different states of India in terms of performance of the primary healthcare system. This can be overcome only by adoption of feasible, cost effective measures like risk approach and hence meet the increased demand using the limited resources. As per a study done by Pandve and

Pandve about Indian primary healthcare system, it is mentioned that the Indian system is extremely rigid and many a times fails to respond effectively according to local needs and realities. However, acute lack of resources in certain states is also identified as a strong contributory factor for this problem (71).

3.6 Role of Community Health Workers in Risk Approach

Various studies across the globe have shown that community level health workers substantially contribute to attain the child survival goals by effective delivery of the primary health services. This is of great importance, especially in developing countries. A systematic review on effectiveness of community health workers done by Perry and Zulliger shows that these grass root level workers help in bringing down preventable causes of childhood mortality, especially in low income countries and in delivering the antenatal, perinatal and postnatal services effectively (72).

Mere improvement of healthcare facilities will not be helpful in averting a large number of child deaths, they need to be provided at the community level. This is because facility-based services focus on curative care over preventive care and children from poor families are less likely to access and utilise these facilities than the children of wealthier families. The bridging of this gap between preventive and curative services is very essential to make health services accessible to the high risk and the poor. Darmstadt et al have shown in their study that an outreach plus family-community approach of health services delivery coupled with about 90 % coverage was effective in reducing neonatal mortality by 18 to 37%, even with no change in facility based healthcare (73), (74).

3.6.1 Community Health Workers in Indian Primary Healthcare System

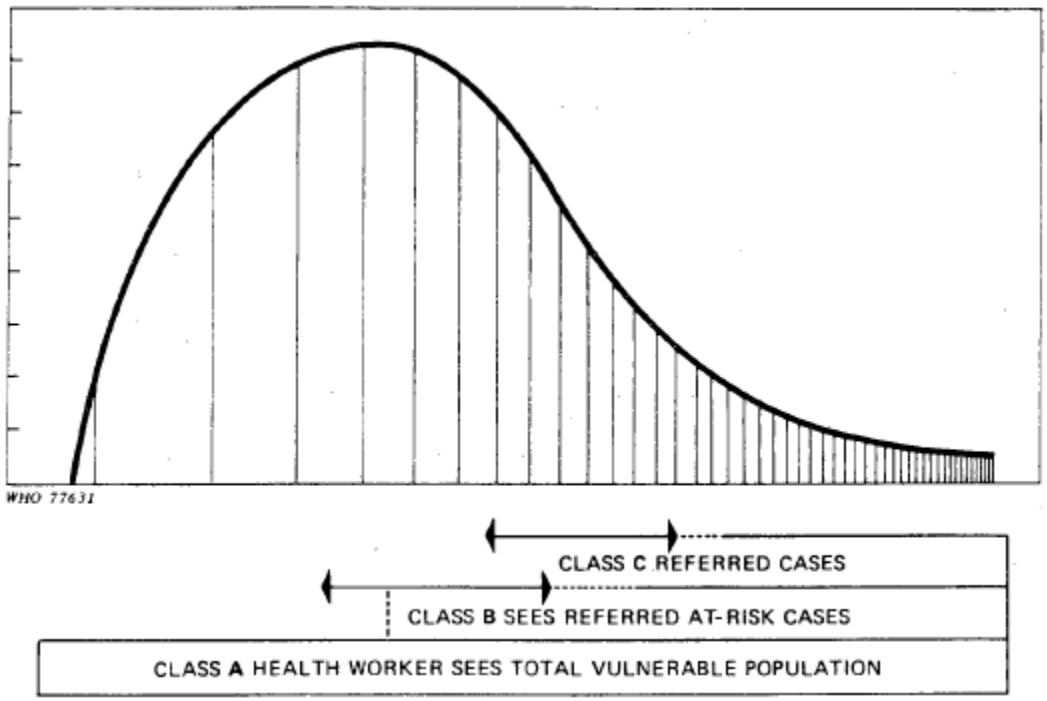
Community Health Workers (CHWs) assumed greater importance with the Alma Ata Declaration of 1978, wherein primary healthcare was identified as the key method to improve community health. WHO recognises CHWs as members of the community who are selected by and hence becomes answerable to the community in which they work, supported by the health system but with lesser training than professional health workers (75).

The Accredited Social Health Activist (ASHA) is a cadre of community level health workers started under the National Rural Health Mission (NRHM) in 2005, by the Government of India. They are 'link workers' who act as vital connecting bridge between the rural, vulnerable population and the health services. They are females identified from the community with definitive communicative and leadership skills and act as agents for social change. Each ASHA covers a population of 1000 and receives a performance and service based honorarium for delivery of maternal and child health and family welfare services. The counterparts of ASHAs working at non-governmental levels are known by various terminologies like health aide, village health worker etc. (76).

3.6.2 Screening by Community Health Workers

Screening is a strategy used to identify disease among asymptomatic people in the population. It is carried out in order to detect those at risk and to plan and execute interventions to prevent further morbidity and mortality. A model for resource allocation at different levels is given below.

Figure 4. Model of Resource Allocation at Three Levels



[Source: WHO Manual on Risk Approach for Maternal and Child Health (5)**]**

The primary level health worker (CHW) screens the entire vulnerable group of people to find out the 'at risk' cases who are then referred to the next level of care, a physician mostly. From there, the cases which need further expertise to manage are referred to the next higher level of care, like neonatologists, paediatric surgeons etc. (5).

Screening programmes substantially reduce unnecessary burden on healthcare system and buys time for planning interventions for those at risk.

The cost effectiveness of CHW initiated screening programmes has been shown in various studies. In an economic assessment of community health programme in Western Kenya by Wang'ombe J K wherein a cost-benefit analysis using willingness-to-pay approach to compare costs and benefits of the programme was done, a large net

present value and a benefit-cost ratio of nine was found. The study voted strongly in favour of decentralisation of primary healthcare in rest of the country based on these results (77).

In a controlled trial conducted in rural Maharashtra, India by Bang et al, it was shown that early identification of warning signs of neonatal sepsis by CHWs combined with prompt referral and supportive care provided for low birth weight children in the intervention group of communities almost halved the neonatal mortality (78).

3.7 Need for Simple Screening Tools

The screening programmes should use simple, user friendly yet reliable and valid tools since a large number of population needs to be screened. An ideal screening tool must be easy to use and produce valid results when used by observers at different levels of skill and knowledge.

3.7.1 Validity and Reliability of Screening Tools

Validity is the ability of a test to distinguish between who has a disease and those who does not. It is expressed in terms of sensitivity and specificity. Sensitivity of a test is the proportion of diseased people who were correctly identified as ‘positive’ by the test. Specificity is the proportion of non diseased people who were correctly identified as ‘negative’ by the test (79).

The test results are compared with some ‘gold standard’ which is an external source of truth regarding the disease status of each individual of the population. The conventional data layout is using a 2 x 2 contingency table.

	Disease Present	**Disease Absent**
Test Positive	True Positive (a)	False Positive (b)
Test Negative	False Negative (c)	True Negative (d)

$$\text{Sensitivity}=\frac{a}{a+c} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Negative}}$$

$$\text{Specificity}=\frac{d}{b+d} = \frac{\text{True Negative}}{\text{True Negative} + \text{False Positive}}$$

The implication of 'false positive' is the unnecessary burden on health services and emotional trauma and stigma to the patient. The patient will have to undergo diagnostic tests to confirm diagnosis, may even be started off on some treatment. The stigma associated with certain diseases like HIV may last long and causes social isolation and psychological stress to the patient even when disease has been ruled out (80).

The implication of 'false negative' can sometimes be lethal due to diagnostic delay and subsequent delay in initiation of treatment. Conditions like cervical cancer which

would have been completely curable if detected earlier but missed out being false negative can cost the life of the patient (81).

The diagnostic accuracy of these tests can be found out in terms of positive and negative predictive values. Positive predictive value (PPV) of a test is the proportion of actually diseased persons detected from those tested positive. Negative predictive value (NPV) is the proportion of actually non-diseased persons detected from those tested negative. PPV & NPV can also be calculated from any prevalence also. The lesser the prevalence of a disease, the more we can be sure that a negative test indicates no disease and less sure that a positive test indicates the real presence of disease (82).

$$\text{PPV} = \frac{b}{a+b} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Positive}}$$

$$\text{NPV} = \frac{d}{c+d} = \frac{\text{True Negative}}{\text{False Negative} + \text{True Negative}}$$

$$\text{PPV} = \frac{\text{Sensitivity x Prevalence}}{\text{Sensitivity x Prevalence} + (1-\text{Specificity}) \text{x} (1-\text{Prevalence})}$$

$$\text{NPV} = \frac{\text{Specificity x} (1-\text{Prevalence})}{(1-\text{Sensitivity}) \text{x Prevalence} + \text{Specificity x} (1-\text{Prevalence})}$$

Reliability is the reproducibility of the test. It is to assess whether a test gives the similar results when repeated in same situations in the same population, which gives an idea about the consistency or dependability of the results (83).

3.7.2 Acceptability of Screening Programmes among the Public

A screening programme in the community must have acceptance among the public to run effectively and yield results. The consideration should be on what to screen for. As per the WHO guidelines for screening programmes by Strong et al, identification of trivial or untreatable conditions cause anxiety and waste of resources with no practical outcome (84).

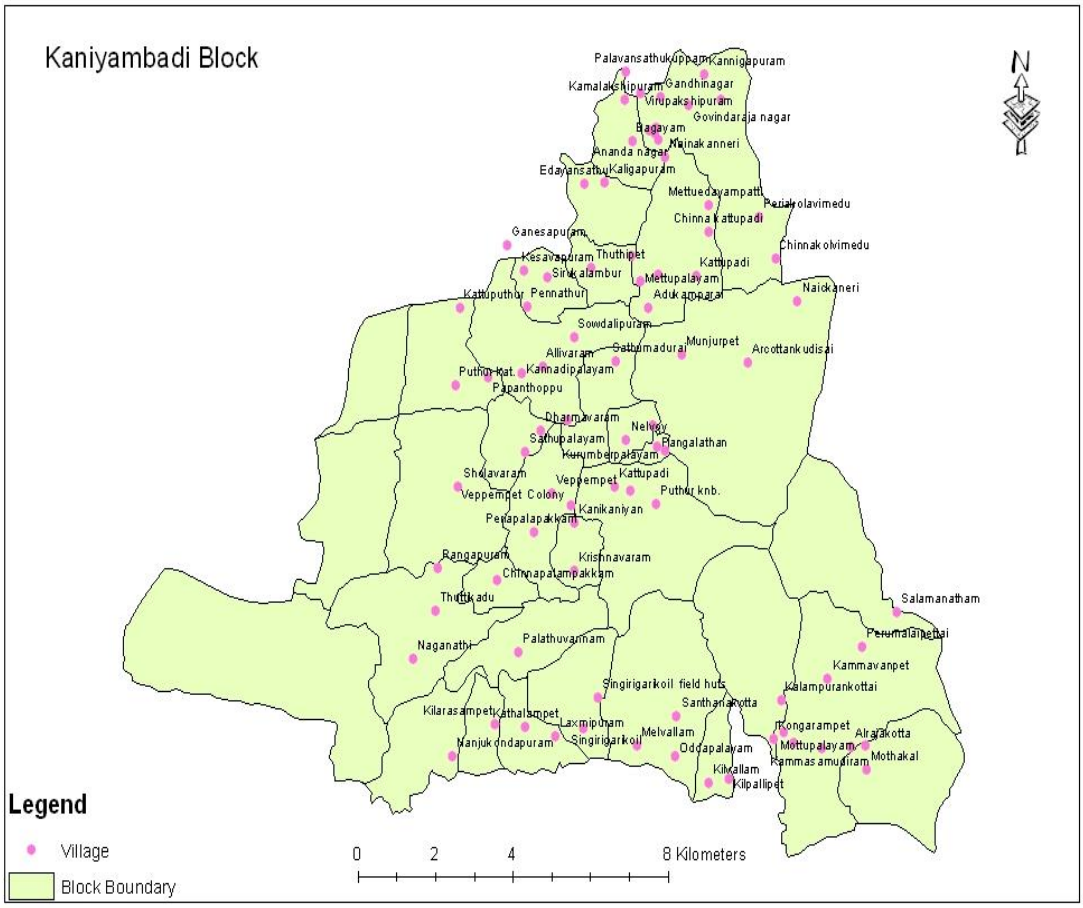
A screening programme can be justified only if it is acceptable among the public clinically, socially and ethically and certain criteria are met. We should value all benefits and harms due to the screening- complications of investigations for conditions detected by screening, unexpected consequences like increased morbidity or mortality due to side effects of screening or subsequent management of the detected condition, overdetection and psychosocial effects. Another factor is that public participation in informed choice should be enabled. Patient autonomy to choose to be screened or not should be given utmost importance. People should have access to information about the benefits and harms of the screening procedure and it is their informed choice to participate in it or not. Local culture should be taken into account while designing screening programmes. (85).

4 MATERIALS & METHODS

4.1 Study Setting

The study was conducted in Kaniyambadi block, Vellore District, Tamil Nadu, India. This block is predominantly rural with a population of approximately one lakh twenty thousand in a total of 82villages.Health care providers within this block include four primary health centres, one Government Medical College, the Department of Community Health of the Christian Medical College (CMC) and numerous private health care providers. A map of this block is given below.

Figure5. Map of Kaniyambadi Block



[Source: CHAD Information System]

The Community Health and Development Program of the Community Health Department, CMC has been providing primary and secondary health care to this block for over 40 years. This is provided through part time community health workers (PTCHW) who form an important link between the community and the public health system. The part time workers share information about the community with the Health Aides who cover a population of about 5000-7000. The Health Aides provide information about various vital events like births, deaths, marriages, pregnancies, immunization coverage, selected communicable diseases especially vaccine-preventable diseases etc. in their respective areas to the Public Health Nurses (PHN) who visit the villages weekly. All pregnancies are recorded in a register and as soon as it results in a live birth, the information is transferred to a 'child register'. The child register is periodically updated to add information regarding immunization, growth monitoring, etc. This data is captured by a statistician and entered into a computerized database. The statistician also verifies and corrects information provided by the health Aides. Monthly and annual reports on mortality, maternal and child health and base hospital activities are generated. The screening in this study was undertaken by the Health Aides (hereafter referred to as Health workers).

4.2 Training of Health Workers

The study had two main components – (a) screening by twelve health workers of the under five children in their respective areas and (b) concurrent validation of the health worker's findings by the principal investigator in a sample of 469 children using the same screening tool.

There were 14 health workers who were permanent staff of CHAD whose routine work included surveying of under five children, antenatal women, lactating mothers etc. Each health worker had 250 to 300 under five children in their respective areas whom they were supposed to visit once in every three months, under normal circumstances. This questionnaire was designed specially to identify the children who were 'at risk'. Since it was meant to be a screening tool and considering the large numbers of children to be screened by each health worker, the questionnaire was made simple, short, objective and user friendly to the maximum extent possible.

The orientation session was conducted on 2nd July 2016 by the principal investigator and lasted for half a day. The 12 health workers (Health Aides) of the CHAD project were the participants of the session. They were supplied the following materials for the session:

1. Semi structured questionnaire (Annexure-2) to be used for the screening programme to identify 'at risk' under five children
2. WHO weight-for-age Z-score Reference standards (Annexures-5,6)
3. Modified BG Prasad scale (Annexure-3)
4. WHO windows of achievement of six gross motor milestones (Annexure-4)

The questionnaire was designed based on the WHO document on 'Risk Approach in Maternal & Child Health' and considering local prevalence of childhood illnesses (5).

The first session for health workers introduced them to the questionnaire to be used for the programme as well as to the reference tools used in the study. The health workers were briefed about the importance of high risk factors among under five

children, the description of the different risk factors, and why it is important to screen children regarding the same. This was followed by an interactive session with the questionnaire and the reference tools wherein each question was read out, explained, demonstrated on how to ask the question, various possible responses, how to classify them, how to mark responses on the questionnaire and how and when to use the reference tools. The queries and doubts of health workers were addressed and they were instructed to carry out screening of under five children in their respective areas which was to be completed during the period July 2016 to June 2017. Two weeks after the first session, after the health workers started screening the children in their own areas, a review session was conducted by the principal investigator and ground level difficulties of health workers in carrying out the screening were discussed, their doubts regarding use of questionnaire and the related tools clarified. Filled questionnaires from the health workers were collected by the principal investigator on a weekly basis.

4.2.1 Inclusion Criteria for the Screening

All children from 0 to 59 months of age in the Kaniyambadi block.

4.2.2 Exclusion Criteria for the Screening

Children who had come to their relatives' houses for a short stay (less than 2 months).

4.3 Use of the Screening Tool

The use of the semi structured questionnaire by the principal investigator and the health workers was based on uniform rules which were according to the reference literature and discussed among and agreed upon by the investigators and explained to the health workers during the orientation session.

4.3.1 Definitions and Guidelines Followed for Screening and Validation

4.3.1.1 Mother's Education

The completed years of education of the mother was asked for and recorded. An education of 5^{th} grade or less was considered as 'at risk'.

4.3.1.2 Socioeconomic Status

The socioeconomic status was based on modified B G Prasad scale which used income per capita per month to classify the subjects into 5 classes- upper, upper middle, middle, lower middle and lower. The total family income per month, number of members in the family and income per capita per month calculated from these values were recorded in separate fields. The cut off values of income per capita per month was referred to and the subjects were classified accordingly. 'Lower' category was considered as 'at risk'.

4.3.1.3 Birth Order

The birth order of the child was asked for and recorded. Still births and early neonatal deaths were counted whereas abortions were not included. A birth order of 4 and above was considered ‘at risk’.

4.3.1.4 Death of either or both parents

Death of the mother, father or both was asked for. The child was classified as ‘at risk’ if either or both parents had expired.

4.3.1.5 Mother working outside more than 8 hours a day

The working status of the mother was asked for and if she was working, the hours of work were documented. The child was classified as ‘at risk’ if the mother was working outside for more than 8 hours a day. Since such a cut off was followed, the mothers who went for the 100 days work scheme by the Government which had only 4 to 5 hours of work and those working from home like cottage industries were classified as not working outside (< 8 hours a day).

4.3.1.6 Gestational Age

The gestational age at which child was born was captured from the antenatal records of the mother. If those were not available, gestational age was calculated from the expected delivery date given to the mother during antenatal check-ups and the actual date of birth of the child.

4.3.1.7 History of death of sibling under 1 year age

Any history of death of a sibling less than one year age was classified as ‘at risk’.

4.3.1.8 Twins

The child was classified as ‘at risk’ if he/she was one among twins, irrespective of whether the other twin was alive or not.

4.3.1.9 Birth Weight

The birth weight of the child was obtained from the immunisation card of the child or the antenatal records of the mother. If these were not available, the birth weight recorded was to be from the history given by the informant. A birth weight of less than 2500 grams was classified as ‘at risk’.

4.3.1.10 Weight for Age

The last recorded weight of the child (within past two months) along with age of the child at the time of recording was collected. This was compared with the WHO Z-scores for weight for age and classified accordingly. A weight for age less than -2 standard deviation was classified as ‘at risk’.

4.3.1.11 History of Hospital Admission

History of hospital admissions as an in-patient for any illness in the past one year was asked for. Casualty observations were not counted as admissions. Any in-patient admission was considered as ‘at risk’.

4.3.1.12 Congenital Heart Disease

History of any congenital heart disease was asked for and if present was categorised as ‘at risk’.

4.3.1.13 History of Central Nervous System Infection

History of meningitis or encephalitis in the child from birth to current age was asked for and if present, was categorised as ‘at risk’.

4.3.1.14 Seizure Disorder

The informant was asked about any seizure disorder in the child. Febrile seizures were excluded. The presence of seizure disorder classified the child as ‘at risk’.

4.3.1.15 Developmental Delay

The attainment of gross motor milestones of the child based on the WHO Windows of Achievement of 6 gross motor milestones was assessed. Any delay classified the child as ‘at risk’.

4.3.1.16 Major Surgery

Any major surgeries done for the child was asked for and if present was categorised as ‘at risk’.

4.4 Methodology of the Validation Study

4.4.1 Objectives

The objective of the validation study was to validate the screening of under five children done by the health workers. It was conducted by the principal investigator in the villages of the Kaniyambadi block from October 2016 to June 2017.The caregiver of the child was interviewed using the semi structured questionnaire after giving informed consent.

4.4.2 Sample Size Calculation

Prevalence of 'at risk' under five children in the community based on previous studies	= 65%
Expected sensitivity of the screening method	= 80%
Margin of error acceptable	d = 5
Number of 'at risk' children needed based on this sensitivity	$= Z^2pq/d^2$ $= 4 \times 80 \times 20 / 5^2$ = 256
Number needed to be screened based on sensitivity	= 256/ Prevalence = 256 / 0.65 = 393
Expected specificity	= 90%

Margin of error acceptable	D=5
Number of ‘at risk’ children needed based on this specificity	=4 x 90 x 10/ (5 x 5) = 144
Number needed to be screened based on specificity	=144/(100-prevalence) = 144 / 0.35 = 411

Combining both the sensitivity & specificity, and accounting for non-response, it was planned to do the validation among 450 children (225 screened positive and 225 screened negative).

4.4.3 Sample Selection

From the filled questionnaires obtained after screening by health workers on a weekly basis, random questionnaires were selected for the validation study by the principal investigator ensuring that the principal investigator was unaware of the responses obtained by the health worker, and only name of the child, parents’ name and address were extracted from these to prepare a separate list. Towards the latter half of the study, another investigator reviewed the list and selected subjects for validation ensuring almost equal numbers of health worker screened ‘at risk’ and screened ‘not at risk’ children.

4.4.4 Data Management

Data collected was entered in Epidata version 3.1 and analysed using SPSS version 20.

5 RESULTS

5.1 Screening by Health Workers

Of the 6,656 children under the age of 5 years in the Kaniyambadi block as per the health information system, 2083 were screened by community health workers (health aides) using the semi structured questionnaire. 67 were excluded due to incomplete data. Finally, **2016 children** were taken for the analysis.

The reasons for the gap in screening included:

1. Limited time period available for completing the screening
2. Superannuation of two health aides from service
3. The database included children of mothers who were temporary residents who had subsequently returned to their permanent residence by the time study started.

Table 5-1. Age distribution of the children screened

Age Group	Number	Percent
0-11 months	377	18.7
1yr-1 yr 11 months	501	24.9
2yrs – 2yrs11 months	456	22.6
3 yrs-3 yrs 11 months	380	18.8
4yrs-4 yrs 11 months	302	15.0
Total	**2016**	**100**

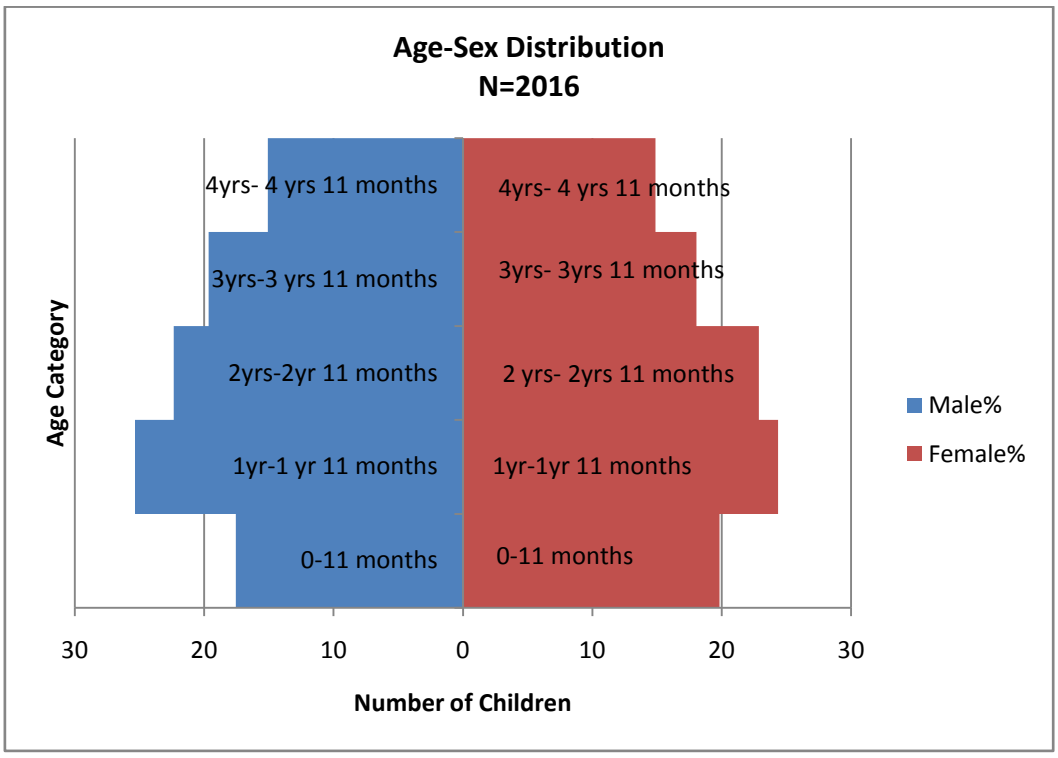
While the number of children was fairly well distributed across each of the one year age groups, the highest proportion of children were in the age group of 1 year - 1 year 11 months.

Table 5-2. Sex Distribution of children

Sex	Number	Percent
Female	1014	50.3
Male	1002	49.7
Total	**2016**	**100**

The proportion of boys and girls were almost the same (50.3% and 49.7%).

Figure 6. Age Sex Distribution of the under 5 children screened by the health workers



The age and sex distribution indicated almost equal proportions of boys and girls across the different age groups.

Table 5-3. Place of birth of the children screened

Birth Place	Number	Percent
Home	18	0.9
Primary Health Centre (Primary Level)	467	23.2
CHAD Hospital (Secondary level)	982	48.7
Other Private Hospital (Secondary level)	68	3.4
Government Hospital (Tertiary level)	301	14.9
CMC Hospital (Tertiary Hospital)	180	8.9
Total	**2016**	**100**

Less than one percent of deliveries were conducted at home. The largest proportion of deliveries was at secondary level facilities, while almost equal proportions were at the primary and tertiary levels.

Table 5-4. Socio-economic Status (SES) of the families of the children screened

SES Category	Number	Percent
Upper	118	5.9
Upper Middle	295	14.6
Middle	609	30.2
Lower Middle	709	35.2
Lower	285	14.1
Total	**2016**	**100.0**

As expected, the lower and middle SES categories accounted for almost 80% of the total population.

Table 5-5. Age of the Mothers of the children screened

Mother's Age	Number	Percent
< 20 years age	14	0.7
20-24 years	644	31.9
25-29 years	926	45.9
30-34 years	355	17.6
≥ 35 years	74	3.7
Total	**2013***	**100**

*3 mothers had expired

The range of maternal ages was from 18 – 47 years, while the mean age was 26.56 years.

The highest proportion of mothers were in the 25 – 29 year age group

143 children were born out of teenage pregnancies (15-19 years).

Table 5-6. Age of the fathers of the children screened

Father's Age	Number	Percent
20-24 years	39	1.9
25-29 years	408	20.2
30-34 years	853	42.3
≥ 35 years	715	35.5
Total	**2015***	**100**

*one unmarried pregnancy for which the father's details were not available

The range of paternal ages was from 21 – 72 years, while the mean age was 33.06 years.

The highest proportion of fathers were in the 30 – 34 year age group

Table 5-7. Education of the mothers of the children screened

Education Category	Number	Percent
No schooling	42	2.1
Primary school (≤ 5th grade)	68	3.4
Middle school (6th to 8th grade)	259	12.8
High School (9th & 10th grade)	685	34.0
Higher secondary (11th & 12th)	503	25.0
Above higher secondary, below graduation	72	3.6
Graduate and above	387	19.2
Total	**2016**	**100**

About 48% of the mothers had studied beyond high school, while only 2 % had no schooling at all.

Table 5-8. Socioeconomic Status Category

SES Category	Number	Percent
Lower	285	14.1
Upper,UpperMiddle,Middle,Lower Middle	1731	85.9
Total	**2016**	**100.0**

Table 5-9. Birth order of the children screened

Birth Order	Number	Percent
1	975	48.4
2	785	38.9
3	216	10.7
4 and above	40	2.0
Total	**2016**	**100.0**

Only 2% of the children were in the birth order category of 4 and above, while 48 % of the children were of birth order 1.

Table 5-10. Death of either or both parents

Status of Parents	Number	Percent
One or both parents died	19	0.9
Both alive	1997	99.1
Total	**2016**	**100**

Among 19 of the children screened (0.9%), one or both parents had expired.

Table 5-11. Mother working outside >8hrs a day

Mother Working	Number	Percent
Working outside >8hrs/day	83	4.1
Not working outside	1933	95.9
Total	**2016**	**100.0**

In approximately 4% of the children, the mothers were away for more than 8 hours a day at work.

Table 5-12. Gestational Age Category

Gestational Age	Number	Percent
≤ 37 weeks	102	5.1
> 37 weeks	1914	94.9
Total	**2016**	**100.0**

Almost 95% of the children were born at term.

Table 5-13. Death of one or more siblings <1 yr age

Sibling Death	Number	Percent
Death of ≥ 1 sibling within 1st year of age	83	4.1
No death of sibling within 1st year of age	1933	95.9
Total	**2016**	**100.0**

Just over 4 % of the children had a history of the death of a sibling within one year ofage.

Table 5-14. Whether subject was one among twins

Twins or not	Number	Percent
Twins	39	1.9
Singleton	1977	98.1
Total	**2016**	**100.0**

39 (almost 2 %) of the children screened were one of twins.

Table 5-15. Birth weight category

Birth Weight	Number	Percent
< 2.5kgs	264	13.1
> or = 2.5kgs	1752	86.9
Total	**2016**	**100.0**

The prevalence of low birth weight among these children was approximately 13%.

Table 5-16. Weight for age category (Current Weight)

Weight-for-Age	Number	Percent
≤ -2 SD of expected	640	31.7
> -2 SD of expected	1376	68.3
Total	**2016**	**100.0**

Almost a third of the children screened had some degree of malnutrition as per the WHO growth standards for weight for age.

Table 5-17. History of hospital admissions in the past 1 year

Hospital Admission	Number	Percent
Admitted	214	10.6
No admissions in past 1 yr	1802	89.4
Total	**2016**	**100.0**

10% of the children had a history of being admitted to a hospital in the last year.

Table 5-18. Presence of Congenital Heart Disease

Congenital Heart Disease	Number	Percent
Congenital heart disease present	13	0.6
No congenital heart disease	2003	99.4
Total	**2016**	**100.0**

The proportion of children with documented congenital heart disease was less than 1%.

Table 5-19. History of CNS infection

CNS Infection	Number	Percent
History of CNS infection present	6	.3
No history of CNS infection	2010	99.7
Total	**2016**	**100.0**

Less than 1% of the children had a history of CNS infection anytime from birth.

Table 5-20. Seizure disorder

Seizure Disorder	Number	Percent
Seizure disorder present	24	1.2
No seizure disorder	1992	98.8
Total	**2016**	**100.0**

Table 5-21. Developmental Delay

Developmental Delay	Number	Percent
Developmental delay present	20	1.0
No developmental delay	1996	99.0
Total	**2016**	**100.0**

Table 5-22. History of any surgery

Major Surgery	Number	Percent
H/o major surgery present	17	.8
No h/o major surgery	1999	99.2
Total	**2016**	**100.0**

Only about 1% of the children had risk factors of seizure disorder, developmental delay or of any surgery.

Table 5-23. Overall at risk/no risk

Risk Status	Number	Percent
At risk	1142	56.6
No risk	874	43.4
Total	**2016**	**100.0**

Over 56% of the children were identified to be at risk based on the screening by the health workers.

Table 5-24. Socio-cultural risk factors

Risk Status	Number	Percent
At risk	450	22.3
No risk	1566	77.7
Total	**2016**	**100.0**

22% of the children screened were identified be at risk based on the presence of any socioeconomic or cultural factors.

Table 5-25. Medical/Surgical risk factors

Risk Status	Number	Percent
At risk	956	47.4
No risk	1060	52.6
Total	**2016**	**100.0**

47% were found to be at risk based on the presence of medical or surgical factors.

Table 5-26. Age Categories

Age Category	Number	Percent
< 1 year	377	18.7
1 to 5 years	1639	81.3
Total	**2016**	**100.0**

Table 5-27. Sex Distribution

Age & Sex		Number	Percent
< 1 yr	**Male**	176	46.7
	Female	201	53.3
1 to 5 yrs	**Male**	826	50.4
	Female	813	49.6

Table 5-28. Age wise Distribution of Risk Factors

Risk Factor		< 1 year (N=377)		1 – 5 years (N=1639)		Chi Square& P value
		No.	(%)	No.	(%)	
Mother's education	≤ 5th grade	15	(4%)	64	(3.9%)	0.004 p=0.947
	>5th grade	362	(96%)	1575	(96.1%)	
Birth Order	4 and above	10	(2.7%)	30	(1.8%)	1.065 p=0.302
	1,2 or 3	367	(97.3%)	1609	(98.2%)	
SES	Lower	41	(10.9%)	244	(14.9%)	4.064 **p=0.044**
	> Lower	336	(89.1%)	1395	(85.1%)	
Death of either or both parents	Died	1	(0.3%)	18	(1.1%)	0.231*
	Alive	376	(99.7%)	1621	(98.9%)	
Mother working>8hrs	> 8hrs	9	(2.4%)	74	(4.5%)	3.515 p=0.061
	≤ 8 hrs	368	(97.6%)	1565	(95.5%)	
Gestational Age	≤37 weeks	24	(6.4%)	78	(4.8%)	1.648 p=0.199
	>37 weeks	353	(93.6%)	1561	(95.2%)	
Death of sibling < 1 year age	Died	16	(4.2%)	67	(4.1%)	0.019 p=0.891
	No death	361	(95.8%)	1572	(95.9%)	
One among twins or not	Twins	7	(1.9%)	32	(2%)	0.015 p=0.903
	Singleton	370	(98.1%)	1607	(98%)	
Birth Weight	<2.5 kgs	48	(12.7%)	216	(13.2%)	0.054 p=0.817
	≥2.5 kgs	329	(87.3%)	1423	(86.8%)	
Weight for Age	Not adequate	114	(30.2%)	526	(32.1%)	0.486 p=0.486
	Adequate	263	(69.8%)	1113	(67.9%)	

Risk factor		< 1 year (N=377)		1 – 5 years (N=1639)		Chi Square & P value
		No.	(%)	No.	(%)	
Hospital admission in past 1 year	Admitted	32	(8.5%)	182	(11.1%)	2.211 p=0.137
	Not admitted	345	(91.5%)	1457	(88.9%)	
Congenital Heart Disease	Present	0	0	13	(0.8%)	0.145*
	Absent	377	(100%)	1626	(99.2%)	
History of CNS infection	Present	0	0	6	(0.4%)	0.601*
	Absent	377	(100%)	1633	(99.6%)	
Seizure disorder	Present	2	(0.5%)	22	(1.3%)	0.290*
	Absent	375	(99.5%)	1617	(98.7%)	
Developmental Delay	Present	6	(1.6%)	14	(0.9%)	1.696 p=0.193
	Absent	371	(98.4%)	1625	(99.1%)	
History of surgery	Present	1	(0.3%)	16	(1%)	0.225*
	Absent	376	(99.7%)	1623	(99%)	
Overall Risk Status	At Risk	201	(53.3%)	941	(57.4%)	2.095 p=0.148
	No Risk	176	(46.7%)	698	(42.6%)	
Risk based on socioeconomic factors alone	At Risk	70	(18.6%)	380	(23.2%)	3.769 p=0.052
	No Risk	307	(81.4%)	1259	(76.8%)	
Risk status based on medical/surgical factors alone	At Risk	174	(46.2%)	782	(47.7%)	0.298 p=0.585
	No Risk	203	(53.8%)	857	(52.3%)	

*Fischer's exact test value since at least one cell has value less than 5

A higher proportion of children in the 1-5 years group were in the lower SES category (14.9%)as compared to the <1 year group (10.9%). There was no statistically significant difference in the other risk factors between the two age groups.

VALIDATION COMPONENT

Of the 2016 screened by health workers, a total of **469 children** were assessed by the principal investigator (PI) using the same semi- structured questionnaire.

The basic demographic information of the 469 children as assessed by the Principal Investigator (PI) is given in tables 5-29 to 5-51 below

Table 5-29. Age of the Children

Age Category	Number	Percent
0-11 months	81	17.3
1 yr- 1yr 11 months	117	24.9
2 yrs- 2yrs 11 months	116	24.7
3yrs- 3yrs 11 months	92	19.6
4yrs – 4 yrs 11 months	63	13.4
Total	**469**	**100**

Table 5-30. Sex of the Children

Sex	Number	Percent
Female	249	53.3
Male	220	46.7
Total	469	100

Figure 7. Age-Sex pyramid of validation study subjects

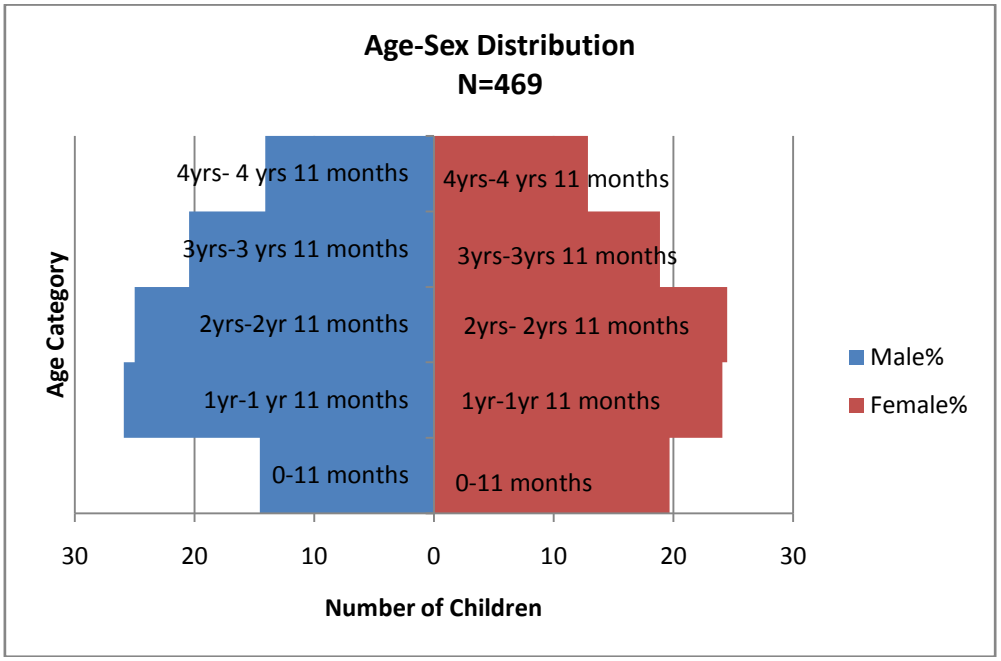


Table 5-31. Age of Mother

Mother's Age	Number	Percent
< 20 years	6	1.3
20-24 years	149	31.8
25-29 years	219	46.7
30-34 years	78	16.6
> or = 35 years	17	3.6
Total	**469**	**100.0**

Table 5-32. Age of Father (PI)

Father's Age	Number	Percent
20-24 years	7	1.5
25-29 years	104	22.2
30-34 years	196	41.8
> or = 35 years	162	34.5
Total	**469**	**100.0**

Table 5-33. Place of birth (PI)

Birth Place	Number	Percent
Home	3	.6
Secondary level CMC (CHAD)	254	54.2
Tertiary level CMC (Main Hospital)	44	9.4
Other Private Hospital (Secondary & Tertiary)	21	4.5
Primary level Government Health Facility (PHC)	91	19.4
Government Hospital (CHC & above)	56	11.9
Total	**469**	**100.0**

Validation Results

Table 5-34.Sex of the Child : Health Worker Vs Principal Investigator

Sex of the Child		PI (Gold Standard)		Total
		Female	Male	
Health Worker	Female	247	0	247
	Male	2	220	222
Total		**249**	**220**	**469**

For the screening by health workers for the sex of the child, the sensitivity was 99.2% and specificity was 100%.

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Table 5-35. Validation of Risk Status based on Socio-economic Status

Socioeconomic Status		PI (Gold Standard)		
		Lower	> Lower	**Total**
Health Worker	Lower	23	19	42
	> Lower	48	379	427
	Total	**71**	**398**	**469**

For the screening by health workers based on SES, the sensitivity was 32.39% and specificity was 95.23%.

Table 5-36. Validation of Risk Status based on Mother's Education

Mother's Education		PI (Gold Standard)		
		$\leq 5^{th}$ grade	$> 5^{th}$ grade	**Total**
Health Worker	$\leq 5^{th}$ grade	16	4	20
	$> 5^{th}$ grade	6	443	449
	Total	**22**	**447**	**469**

For the screening by health workers based on mother's education, sensitivity was 72.73% and specificity was 99.11%.

Table 5-37. Validation of Risk Status based on Birth Order

Birth Order		PI (Gold Standard)		
		≥ 4	1 or 2 or 3	**Total**
Health Worker	≥ 4	4	2	6
	1 or 2 or 3	1	462	463
	Total	**5**	**464**	**469**

For the screening by health workers based on birth order, the sensitivity was 80% and specificity was 99.57%.

Table 5-38. Validation of Risk Status based on Death of either or both parents

Death of either or both parents		PI (Gold Standard)		
		One or both parents died	Both alive	**Total**
Health Worker	One or both parents died	6	1	7
	Both alive	0	462	462
	Total	**6**	**463**	**469**

For screening by health workers based on death of either or both parents, the sensitivity was 100% and specificity was 99.78%.

Table 5-39. Validation of Risk Status based on Working status of mother

Working Status of Mother		PI (Gold Standard)		
		Working elsewhere > 8 hrs a day	Not Working elsewhere > 8 hrs a day	**Total**
Health Worker	Working elsewhere > 8 hrs a day	5	9	14
	Not Working elsewhere > 8 hrs a day	4	451	455
	Total	**9**	**460**	**469**

For screening by health workers based on working status of mother, the sensitivity was 55.56% and specificity was 98.04%.

Table 5-40. Validation of Risk Status based on Gestational Age at birth

Gestational Age at birth		PI (Gold Standard)		
		≤ 37 weeks	> 37 weeks	**Total**
Health Worker	≤ 37 weeks	7	4	11
	> 37 weeks	12	446	458
	Total	**19**	**450**	**469**

For screening by health workers based on gestational age at birth, the sensitivity was 36.84% and specificity was 99.11%.

Table 5-41. Validation of Risk Status based on death of any sibling within 1st year of life

Death of any sibling within 1st year of life		PI (Gold Standard)		
		Present	Absent	**Total**
Health Worker	Present	9	6	15
	Absent	9	445	454
	Total	**18**	**451**	**469**

For screening by health workers based on sibling deaths, the sensitivity was 50% and specificity was 98.67%.

Table 5-42. Validation of Risk Status based on Singleton/Twin Pregnancy

Singleton/Twin Pregnancy		PI (Gold Standard)		
		Twins	Singleton	**Total**
Health Worker	Twins	5	0	5
	Singleton	0	464	464
	Total	**5**	**464**	**469**

For the screening by health workers based on whether one among twins or not, the sensitivity and specificity were 100%.

Table 5-43. Validation of Risk Status based on Birth Weight

Birth Weight		PI (Gold Standard)		
		< 2.5 kg	≥ 2.5 kg	**Total**
Health Worker	< 2.5 kg	36	6	42
	≥ 2.5 kg	23	404	427
	Total	**59**	**410**	**469**

For screening by health workers based on birth weight, the sensitivity was 61.02% and specificity was 98.54%.

Table 5-44. Validation of Risk Status based on Nutritional Status

Nutritional Status (Weight for Age)		PI (Gold Standard)		
		Not adequate	Adequate	**Total**
Health Worker	Not adequate	62	59	121
	Adequate	46	302	348
	Total	**108**	**361**	**469**

Sensitivity was 57.41% and specificity was 83.66%.

Table 5-45. Validation of Risk Status based on history of hospital admissions in past 1 year

Hospital admission in past one year		PI (Gold Standard)		
		Admitted to Hospital	No Hospital admission	**Total**
Health Worker	Admitted to Hospital	16	12	28
	No Hospital admission	29	412	441
	Total	**45**	**424**	**469**

For the screening by health workers based on history of hospital admissions, sensitivity was 35.56% and specificity was 97.17%.

Table 5-46. Validation of Risk Status based on presence of congenital heart disease

Congenital Heart Disease		PI (Gold Standard)		
		Congenital Heart Disease present	No Congenital Heart Disease	**Total**
Health Worker	Congenital Heart Disease present	0	0	0
	No Congenital Heart Disease	0	469	469
	Total	**0**	**469**	**469**

The specificity of screening by health workers based on congenital heart disease was 100%.

Table 5-47. Validation of Risk Status based on History of CNS infection

History of CNS infection		PI (Gold Standard)		
		History of CNS infection present	No history of CNS infection	**Total**
Health Worker	History of CNS infection present	1	2	3
	No history of CNS infection	2	464	466
	Total	**3**	**466**	**469**

For screening by health workers based on history of CNS infection, sensitivity was 33.33% and specificity was 99.57%.

Table 5-48. Validation of Risk Status based on presence of a seizure disorder

Seizure Disorder		PI (Gold Standard)		
		Seizure disorder present	No seizure disorder	**Total**
Health Worker	Seizure disorder present	1	3	4
	No seizure disorder	0	465	465
	Total	**1**	**468**	**469**

For screening by health workers based on presence of seizure disorder, the sensitivity was 100% and specificity was 99.36%.

Table 5-49. Validation of Risk Status based on Presence of Developmental Delay

Developmental Delay		PI (Gold Standard)		
		Developmental delay present	No developmental delay	**Total**
Health Worker	Developmental delay present	1	0	1
	No developmental delay	3	465	468
	Total	**4**	**465**	**469**

For screening by health workers based on presence of developmental delay, sensitivity was 25% and specificity was 100%.

Table 5-50. Validation of Risk Status based on History of Major Surgery

History of Major Surgery		PI (Gold Standard)		
		Present	Absent	**Total**
Health Worker	Present	2	0	2
	Absent	3	464	467
	Total	**5**	**464**	**469**

For screening by health workers based on history of major surgery, sensitivity was 40% and specificity was 100%.

Table 5-51. Overall Validation of Risk Categorization

		PI (Gold Standard)		
		At risk	No Risk	**Total**
Health Worker	At risk	153	44	197
	No risk	78	194	272
	Total	**231**	**238**	**469**

The overall sensitivity for screening by health workers was 66.23% and overall specificity was 81.51%.

Estimation of overall prevalence of 'at risk under children

Prevalence of 'at risk' under five children from Health workers screening

=56.6% (1142 out of 2016)

$$\text{True prevalence} = \frac{\text{Apparent prevalence} + \text{Specificity} - 1}{\text{Sensitivity} + \text{Specificity} - 1}$$

$$= \frac{0.566 + 0.8151 - 1}{0.6623 + 0.8151 - 1}$$

$$= 79.82\%$$

6 DISCUSSION

6.1 Discussion of Methodology

6.1.1 Tools

The semi structured questionnaire for screening under five children was a one page questionnaire designed based on the risk factors mentioned in the WHO manual for Risk Approach for Maternal and Child Healthcare and considering the risk factors which were of high prevalence in the study setting. The WHO recommends intervention programmes for healthcare to be tailored for each community considering the local problems in various fields. Since the questionnaire was meant for the purpose of screening, it was kept as simple, objective and concise as possible. This made it more user friendly as large numbers of children were to be screened but had the disadvantage of failure to pick up certain specific information.

The modified B G Prasad scale was based on income per capita per month. The subjects were classified into one of the five economic classes given by the scale based on the different reference values given. This scale was used since the study was conducted in a rural area and since it only included calculations based on total family income per month and number of family members, it was easier to calculate socioeconomic status for large number of study subjects. Also, the modified B G Prasad scale is applicable to individuals as well as families. However, it is debatable as to whether taking only one indicator, that is, income to calculate socioeconomic status is adequate. Also it does not differentiate income and wealth, as in low income families may have assets with value, which are not specifically picked up by this scale (86).

The WHO has a weight-for-age Z-score chart for each age group under 5 years and separate for boys and girls. The Z score system expresses the anthropometric value as number of standard deviations or Z scores below or above the reference/median value. Weight-for-age is an easily obtainable measurement for large population. Reference tables were used which had age and sex specific ideal weight and weight less than -2 standard deviations. However the nutritional status of child under five years of age is best given by integration of three indicators- weight for age, weight for height and height for age (46).

6.2 Discussion of Sociodemographic Features of the Population Studied

6.2.1 Age Distribution

Table 5-1 shows the age distribution of children screened by the health workers. The highest proportion of 24.9% was from the age group of 1 year to 1 year 11 months followed by 2 years to 2 year 11 months which was 22.6%. Table 5-29 shows the age distribution of 469 subjects taken for validation study, where the 1 year to 1 year 11 months age group was of highest proportion of 24.9%.

The under 1 year age group was 18.7% in the screening survey and 17.3% in the validation study. The study included children who were residing in the Kaniyambadi block, irrespective of whether they were temporary or permanent residents. The local tradition of staying in the maternal house for delivery of the first child and continuing to stay there till child completes 6 months to 1 year age, would have been the reason for a lower number of children in the under one year age group. The questionnaire did

not collect the information on whether the child was a temporary or permanent resident.

6.2.2 Sex Distribution

The number of girls and boys in the screening component of the study were almost equal, 50.3% girls and 49.7% boys (Table 5-2). The validation study had 53.3% girls and 46.7% boys (Table 5-30). The World Health Organisation defines population sex ratio as number of males per 100 females. In India, for all census purposes and demographic calculations, sex ratio is defined as the number of females per 1000 males. Child sex ratio is calculated among the age group of 0-6 years. The 2011 Census data showed a child sex ratio of 946 in Tamil Nadu. Sex ratio at birth is the number of male births per 100 female births internationally, whereas in India it is number of female births per 1000 male births(87),(88). The sex ratio at birth for India for the year 2015-16 was 991 and Tamil Nadu was 954 (3), (4). The child sex ratio calculated from the study is 1011 females per 1000 males, which indeed is a favourable one for females.

6.2.3 Place of Birth of the Child

The Government of India recommends 100% institutional delivery and promotes skilled assistance at birth. According to NFHS-4 data, for overall India, the proportion of institutional deliveries was 78.9% with 52.1% of it happening in public health facilities. 4.3% of total deliveries were conducted at home by a skilled health personnel (3). Tamil Nadu reported 99% institutional deliveries, out of which 66.7%

happened in public health facilities. 0.6% out of total deliveries was conducted at home by skilled health personnel (4).

In this study which was done in the Kaniyambadi block, out of the 2016 children screened by health workers, the largest proportion of 48.7% were born in the Community Health And Development Hospital, which is a secondary level hospital run by the Community Health department of Christian Medical College, Vellore. 23.2% children were born in primary health centres run by the Government of Tamil Nadu (Table 5-3). This shows the efficient network of primary health care system run by the State. The validation study had 54.2% born in CHAD Hospital and 19.4% born in Government-run primary health centres (Table 5-33).As a whole, the study population had 61% children who were born in a private healthcare facility, 38.1% who were born in a public health facility run by the Government and 0.9% who were born at home. The reasons for these home deliveries included sudden unprecedented onset of labour, delivery in the vehicle before reaching hospital, bad terrain worsened by adverse climatic condition which hindered going out to the hospital etc.

6.2.4 Socioeconomic Status

Table 5-4 shows the socioeconomic status of the population screened by the health workers. They were classified into 5 classes based on the modified B G Prasad scale which was based on monthly income per capita (21). The lower middle class constituted 35.2%, middle class 30.2%, upper middle class 14.6%, lower class 14.1% and upper class 5.9%. Since the study was conducted in a rural setting and since large numbers of children were to be screened by health workers, this scale was selected to assess socioeconomic status. It has been shown in studies across the World that

income has a linear influence on child health; children from better income families have better access to healthcare facilities, better child rearing practices render them healthier and psychosocial environment is also better in the high income group (89).

6.2.5 Age of Parents

The age of parents is a crucial factor determining child health. An under five child being in the dependent age group, highly relies on the primary caregiver for all activities. In this study, the largest proportion of mothers was in the age group 25-29 years (Table 5-5), about 45.9%. The minimum age was 18 years and maximum age was 47 years. The mean age of mothers was 26.56 years. The largest proportion of fathers was in the age group of 30-34 years (Table 5-6), about 42.3%. The legally marriageable age for males and females in India is 18 years. However, teenage marriages are quite common in rural India. This leads to early sexual activity and resultant pregnancies. In this study, 67 mothers were pregnant at the age of 19 years, 60 mothers at 18 years age, 11 at 17 years age and 5 at 16 years age, giving a total of 143 teenage pregnancies out of the screened population. Various studies done in South India alone have shown that teenage mothers are at higher risk of preterm delivery and having low birth weight babies- the risk being 1.8 times and 2 times more than adult pregnancies, respectively (90), (91).

6.3 Discussion of Prevalence of Various Risk Factors among Population Studied

The prevalence of various risk factors among the under five population studied are discussed below.

6.3.1 Education of Mother

Maternal education plays vital role in a child's growth and development.An educated mother would have better know how of common childhood illnesses, good child rearing practices etc. and hence increased understanding about the importance of vulnerability of under five children to diseases, need for prompt healthcare seeking, good nutrition, immunization etc. In the screening done by health workers in this study, the highest proportion of mothers was those who had completed either 9^{th} or 10^{th} grade of schooling, about 34% (Table 5-7). 25% mothers had higher secondary education, 19.2% were graduates and above, 12.8% had middle school education, 3.4% had only primary schooling and 2.1% had no schooling at all. This reflects the general trend of education among the women in the rural population. It is a cultural practice to get girls married soon after attaining menarche or within a few years of attaining menarche, after which they do not pursue further studies. Olden days witnessed lesser enrolment of girls into schools which has improved drastically now due to consistent efforts by the Government to ensure compulsory, free primary education to all children through various initiatives like Sarva Shiksha Abhiyan, welfare schemes for school students like cash incentives, supply of laptops, school uniforms etc. free of cost and enforcement of the Tamil Nadu Right of Children to Free and Compulsory Education Rules 2011. According to the statistics of state government of Tamil Nadu, the enrolment rates of children into primary school was 51.45% for boys and 48.55% for girls in the year 2016; the enrolment rates to upper primary level was 51.21% for boys and 48.79% for girls. The school dropout rates have reduced from 5.74 lakhs in the year 2002 to 41,034 in 2016. The completion

rates have also improved from 64% in the year 2001 to 98.3% in 2016 for primary level and 68% in 2001 to 96.7% in 2016 for upper primary level (92).

Maternal schooling of 5^{th} grade and below was taken as 'risk' factor in this study and 3.9% mothers fell into this category. The children of mothers with no primary education have been shown to be at disadvantage in terms of healthcare seeking behaviour in studies done earlier (93).

6.3.2 Birth Order

A birth order of 4 and above was considered as 'risk' factor for this study, according to the WHO Risk Approach guidelines. Abortions were not considered for calculating birth order, but early neonatal deaths and stillbirths were included. 2% children in the study had a birth order of 4 and above (Table 5-9). The mean birth order of the study population was 1.66. The District Level Facility and Household Survey-4 (DLFHS-4) for Tamil Nadu done in 2012-13 reports that 12.6% of women aged 15- 49 years reported a birth order of 3 and above. The mean number of children born to the above mentioned age group of women, according to the survey, was 2.3 (94).

6.3.3 Death of either or both Parents

Parental care is of utmost importance in child growth and development. Death of one or both parents can have devastating effects on physical, mental and emotional health of the child. In this study, 0.9% children lost either or both parents to death (Table 5-10).

6.3.4 Working Mother

Working mother has a positive and negative impact on child health. While increased income and social participation by the mothers provides a better physical environment for child development, reduced time spent together by the mother and child has adverse effects, predominant effects being compromised breastfeeding, failure to recognise early symptoms of childhood illnesses, less emotional bonding etc. (95).

In this study, mother working outside the house environment for more than 8 hours a day was taken as 'risk' factor (5). Table 5-11 shows the proportion of working mothers according to this criterion as 4.1%. The predominant occupation of women in this particular study setting was agricultural work, mostly in fields adjoining their houses, and the unskilled manual works in local areas under the Mahatma Gandhi National Rural Employment Guarantee Scheme (MNREGA) popularly known as '100 days work'. Since these works did not involve staying away from the child for more than 8 hours a day, the mothers doing these works were classified as 'not working outside'. The NFHS-4 data for Tamil Nadu showed the proportion of working mothers as 25.2% (4).

6.3.5 Gestational Age at Delivery

In this study, the proportion of preterm births was 5.1% (Table 5-12). In India, about 12-13% of total child births are preterm (96). The prevalence of preterm birth in Tamil Nadu according to a study done by Sounderrajan et al was 5.6% (97).Children born preterm are more likely to be low birth weight and have more morbidities and mortality. This implicates the need for active interventions to prevent preterm birth

during antenatal period itself like prompt treatment of maternal urinary tract infections and need for up scaling of neonatal resuscitation and care facilities in hospitals.

6.3.6 Sibling Death

The study recorded a proportion of 5.1% children who had death of one or more siblings before 1 year of age completion (Table 5-13). Deaths during infancy are more likely to have an effect in the consequent children as hereditary factors come into play. Infant Mortality Rate of Tamil Nadu was 27 per 1000 live births in 2015-16 period. Though it is better compared to the national IMR of 41 per 1000 live births, it points to the need for sustained efforts towards improving child health in the state (3), (4).

6.3.7 Twin Birth

Table 5-14 shows that the study population had 1.9% twins. A prospective study done by Rao et al in the study setting previously had shown a twinning rate of 8.7 per 1000 deliveries (98).

6.3.8 Birth Weight

The proportion of low birth weight (LBW) babies was 13.1% in the study (Table 5-15). Among them, 97.3% was very low birth weight (less than 1500 grams at birth) and 2.7% was extremely low birth weight (less than 1000 grams). Mean birth weight of LBW babies was 1970 grams. The overall mean birth weight of the population screened was 2900 grams, the maximum being 4600 grams and minimum being 1170 grams. The prevalence of LBW in Tamil Nadu according to DLFHS-4 data was 11.4%, which shows that the problem of low birth weight is on a rise (94).

6.3.9 Weight for Age

The prevalence of underweight (less than or equal to -2 standard deviations of weight-for-age Z score) children obtained from this study was 31.7% (Table 5-16). The NFHS-4 data showed prevalence of underweight children to be 35.7% for India and 23.8% for Tamil Nadu(3), (4). This is a matter of concern since Tamil Nadu is a state where efficient steps are taken by the Government to combat the problem of food insecurity and malnutrition through various schemes, despite which undernourishment is still on the higher side.

6.3.10 Hospital Admissions

Table 5-17 shows that 10.6% children had in-patient admission for any illness during the past one year. Acute diarrhoeal diseases and acute respiratory infections dominate the reasons for hospital admissions.

6.3.11 Congenital Heart Disease

Table 5-18 shows that the prevalence of congenital heart disease among the children studied was 0.6%. A prevalence study conducted among Anganwadi children in Vellore by Rupa et al showed 0.05% children affected by congenital heart disease (99).

6.3.12 CNS Infection

Table 5-19 shows the history of central nervous system infection anytime from birth among the screened children to be 0.3%. The annual incidence of meningitis among under five children in Vellore was reported as 86 per 1 lakh children in a prospective study done by Minz et al (100).

6.3.13 Seizure Disorder

Table 5-20 shows the proportion of seizure disorder children among screened population to be 1.2%. However, febrile seizures occurring in this age group was not included.

6.3.14 Developmental Delay

1% children in the study was found to have developmental delay using the WHO tool (Table 5-21). More sensitive tools to pick up developmental delay are required to estimate the actual prevalence.

6.3.15 History of Surgery

0.8% children among the screened population had history a major surgery in the past (Table 5-22). Congenital heart disease correction surgeries and surgery for undescended testis are the commonest surgeries in this age group.

6.3.16 Overview of Prevalence Data

Considering all the risk factors mentioned above, the proportion of 'at risk' under five children from the health workers' screening was found out to be 56.6% (Table 5-23). When only the sociocultural risk factors like mother's education, socioeconomic status, birth order, death of either or both parents and mother working outside were considered, the prevalence of 'at risk' children came to 22.3% (Table 5-24) and when only medical/surgical risk factors were considered, the prevalence came to 47.4% (Table 5-25). Table 5-28 gives the age wise distribution of various risk factors. There was no significant difference in the prevalence of various risk factors or overall risk status except lower SES among children under 1 year age and 1 to 5 years age.

6.4 Discussion of the Validation Study

The validation study by the principal investigator on 469 children out of the 2016 screened by the health workers was carried out using the same questionnaire. Tables 5-34 to 5-51 show the results of the validation. The sensitivity and specificity of screening by the health worker was calculated by considering the principal investigator as the gold standard. Sensitivity of screening was low for domains like socioeconomic status, working mother, gestational age, sibling death, weight for age, history of hospital admissions, history of CNS infection, developmental delay and history of surgery. However, specificity was high for these domains. The overall sensitivity was 66.23% and specificity was 81.51% (Table 5-51). The apparent prevalence of 'at risk' under five children calculated from the health workers' screening data was used to calculate the projected true prevalence, which came to 79.82% (101).

The importance of recognising the 'at risk' under five children is to be able to offer appropriate care and services be it in a health facility or in their homes in the community. Further analysis of actual causes of under five morbidity and mortality and their risks would provide us with the much needed information on how this additional component of care can be optimally targeted keeping in mind the limited resources available especially in low and middle income countries.

7 LIMITATIONS

- All the risk factors considered in the study were assessed based on history given by the informant or available records. Disparities in information given by the informant to the interviewer (health worker or principal investigator) might have led to misclassification, especially the question on family income for calculating socioeconomic status.
- Limited amount of time given to the health workers to screen the large number of children for the study along with their routine work would have affected the data collection.

8 CONCLUSIONS AND RECOMENDATIONS

8.1 Conclusions

- The prevalence of ‘at risk’ under five children in Kaniyambadi block during the period of October 2016 to June 2017 from the screening by health workers is 56.6% and the projected prevalence is found to be 79.82%.
- Inadequate weight for age (31.7%), followed by low socioeconomic status (14.1%) are the major risk factors among the children studied.
- The health workers require more intensive training to recognise the risk factors among these vulnerable groups of children as indicated by the overall sensitivity of 66.23% and specificity of 81.51% of screening by health workers.

8.2 Recommendations

- A registry containing the details of all the ‘at risk’ under five children in the Kaniyambadi block must be created in the hospital information system so that they can be easily recognised and followed up.
- The children having sociocultural risk factors can be given more care at home level by giving health education to parents and followed up by health workers during home visits.
- The children with medical or surgical risk factors should be followed up by home visits as well as in hospital, once or twice a year.
- Health workers should be given a reorientation programme for skill development once in six months on a regular basis.

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ANNEXURE-1: Institutional Review Board Approval Letter

OFFICE OF RESEARCH
INSTITUTIONAL REVIEW BOARD (IRB)
CHRISTIAN MEDICAL COLLEGE, VELLORE, INDIA

Dr. B.J. Prashantham, M.A., M.A., Dr. Min (Clinical)
Director, Christian Counseling Center,
Chairperson, Ethics Committee.

Dr. Alfred Job Daniel, D Ortho MS Ortho DNB Ortho.
Chairperson, Research Committee & Principal

Dr. Biju George, MBBS., MD., DM
Deputy Chairperson,
Secretary, Ethics Committee, IRB
Additional Vice-Principal (Research)

June 15, 2016

Dr. [redacted]
PG Registrar,
Department of Community Health,
Christian Medical College,
Vellore 632 004.

Sub: **Fluid Research Funding: New Proposal**
Establishing a registry of 'at risk' under five children through screening by health workers in a rural area of Tamil Nadu.
[redacted] Employment Number: 21192, PG Registrar, Department of Community Health, Dr. Vinod Joseph Abraham, Employment Number: 28095 Community Health, Dr. Anuradha Bose, Employment No: 0459, Community Health.,

Ref: IRB Min No: 9819 [OBSERV] dated 07.01.2016

Dear [redacted]

I enclose the following documents:-

1. Institutional Review Board approval 2. Agreement

Could you please sign the agreement and send it to Dr. Biju George, Addl. Vice Principal (Research), so that the grant money can be released.

With best wishes,

Dr. Biju George
Secretary (Ethics Committee)
Institutional Review Board

Dr. BIJU GEORGE
MBBS., MD., DM.
SECRETARY - (ETHICS COMMITTEE)
Institutional Review Board,
Christian Medical College, Vellore - 632 002.

Cc: Dr. Vinod Joseph Abraham, Dept. of Community Health, CMC

1 of 4

OFFICE OF RESEARCH
INSTITUTIONAL REVIEW BOARD (IRB)
CHRISTIAN MEDICAL COLLEGE, VELLORE, INDIA

Dr. B.J. Prashantham, M.A., M.A., Dr. Min (Clinical)
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Chairperson, Ethics Committee.

Dr. Alfred Job Daniel, D Ortho MS Ortho DNB Ortho.
Chairperson, Research Committee & Principal

Dr. Biju George, MBBS., MD., DM
Deputy Chairperson,
Secretary, Ethics Committee, IRB
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June 15, 2016

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PG Registrar,
Department of Community Health,
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Vellore 632 004.

Sub: **Fluid Research Funding: New Proposal**
Establishing a registry of 'at risk' under five children through screening by health workers in a rural area of Tamil Nadu.
Dr. [redacted] Employment Number: 21192, PG Registrar, Department of Community Health, Dr. Vinod Joseph Abraham, Employment Number: 28095 Community Health, Dr. Anuradha Bose, Employment No: 0459, Community Health.,

Ref: IRB Min No: 9819 [OBSERV] dated 07.01.2016

Dear Dr. [redacted]

The Institutional Review Board (Blue, Research and Ethics Committee) of the Christian Medical College, Vellore, reviewed and discussed your project titled "Establishing a registry of 'at risk' under five children through screening by health workers in a rural area of Tamil Nadu" on January 07th 2016.

The Committee reviewed the following documents

1. IRB Application format
2. Questionnaire(English and Tamil)
3. Patient Information and Informed Consent Form (English and Tamil)
4. Cvs of Drs. Vinod Abraham, Anuradha Bose, Swathi Krishna .N
5. No. of documents 1- 4

The following Institutional Review Board (Blue, Research & Ethics Committee) members were present at the meeting held on January 07th 2016 in the CREST/SACN Conference Room, Christian Medical College, Bagayam, Vellore 632002.

Ethics Committee Blue, Office of Research, 1st Floor, Carman Block, Christian Medical College, Vellore, Tamil Nadu 632 002
Tel: 0416 – 2284294, 2284202 Fax: 0416 – 2262788, 2284481 E-mail: research@cmcvellore.ac.in

Dr. B.J. Prashantham, M.A., M.A., Dr. Min (Clinical)
Director, Christian Counseling Center,
Chairperson, Ethics Committee.

Dr. Alfred Job Daniel, D Ortho MS Ortho DNB Ortho.
Chairperson, Research Committee & Principal

Dr. Biju George, MBBS., MD., DM
Deputy Chairperson,
Secretary, Ethics Committee, IRB
Additional Vice-Principal (Research)

Name	Qualification	Designation	Affiliation
Dr. Biju George	MBBS, MD, DM	Professor, Haematology, Research), Additional Vice Principal , Deputy Chairperson (Research Committee), Member Secretary (Ethics Committee), IRB, CMC, Vellore	Internal, Clinician
Dr. RV. Shaji		Professor, Heamatology, CMC, Vellore	Internal, Basic Medical Scientist
Dr. Mathew Joseph	MBBS, MCH	Professor, Neurosurgery, CMC, Vellore	Internal, Clinician
Rev. Joseph Devaraj	BSc, BD	Chaplaincy Department, CMC, Vellore	Internal, Social Scientist
Dr. Balamugesh	MBBS, MD(Int Med), DM, FCCP (USA)	Professor, Pulmonary Medicine, CMC, Vellore	Internal, Clinician
Dr. Visalakshi. J	MPH, PhD	Lecturer, Biostatistics, CMC, Vellore	Internal, Statistician
Dr. Rajesh Kannangai	MD, PhD.	Professor, Clinical Virology, CMC, Vellore	Internal, Clinician
Dr. Niranjan Thomas	DCH, MD, DNB (Paediatrics)	Professor, Neonatology, CMC, Vellore	Internal, Clinician
Mrs. Pattabiraman	BSc, DSSA	Social Worker, Vellore	External, Lay Person
Dr. B. J. Prashantham	MA(Counseling Psychol MA(Theology), Dr. Min(Clinical Counselling)	Chairperson, Ethics Committee, IRB. Director, Christian Counseling Centr Vellore	External, Social Scientist
Dr. Ratna Prabha	MBBS, MD (Pharma)	Associate Professor, Clinical Pharmacology, CMC, Vellore	Internal, Pharmacologist
Dr. Anand Zachariah	MBBS, PhD	Professor, Medicine, CMC, Vellore	Internal, Clinician
Mrs. Emily Daniel	MSc Nursing	Professor, Medical Surgical Nursing, CMC, Vellore	Internal, Nurse

Ethics Committee Blue, Office of Research, 1st Floor, Carman Block, Christian Medical College, Vellore, Tamil Nadu 632 002
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Chairperson, Research Committee & Principal

Dr. Biju George, MBBS., MD., DM
Deputy Chairperson,
Secretary, Ethics Committee, IRB
Additional Vice-Principal (Research)

Dr. Vivek Mathew	MD (Gen. Med.) DM (Neuro) Dip. NB (Neuro)	Professor, Neurology, CMC, Vellore	Internal, Clinician
Mr. C. Sampath	BSc, BL	Advocate, Vellore	External, Legal Expert
Dr. Simon Pavamani	MBBS, MD	Professor, Radiotherapy, CMC, Vellore	Internal, Clinician
Dr. Inian Samarasam	MS, FRCS, FRACS	Professor, Surgery, CMC, Vellore	Internal, Clinician
Dr. Thomas V Paul	MD, DNB(Endo), Phd(Endo)	Professor, Endocrinology, CMC, Vellore	Internal, Clinician

We approve the project to be conducted as presented.

Kindly provide the total number of patients enrolled in your study and the total number of withdrawals for the study entitled: "Establishing a registry of 'at risk' under five children through screening by health workers in a rural area of Tamil Nadu" on a monthly basis. Please send copies of this to the Research Office (research@cmcvellore.ac.in)

Fluid Grant Allocation:

A sum of 39,000/- INR (Rupees Thirty Nine Thousand) will be granted for 2 years and out of which a maximum of Rs.5000/- can be spent for stationery, printing, Xeroxing and computer charges(if computers used are within the institution)

Yours sincerely,

Dr. Biju George
Secretary (Ethics Committee)
Institutional Review Board

Dr. BIJU GEORGE
MBBS., MD., DM.
SECRETARY - (ETHICS COMMITTEE)
Institutional Review Board,
Christian Medical College, Vellore - 632 002.

IRB Min No: 9819 [OBSERV] dated 07.01.2016

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Tel: 0416 – 2284294, 2284202 Fax: 0416 – 2262788, 2284481 E-mail: research@cmcvellore.ac.in

ANNEXURE-2: Questionnaire

Department of Community Health, CMC Vellore

SCREENING TOOL FOR 'AT RISK' UNDER FIVE CHILDREN

1. Sample ID No: 2. HA No: 3. Village No: 4. Serial No: 5. Date of visit:

6.Name:

7.Age: yrs months 8.DOB of subject:

9. Sex: Male / Female / Others 10.CHAD Hospital No:

11.Informant's name: 12.Relationship with subject:

13.Mother's name: 14.Mother's age:

15.Father's name: 16.Father's age:

17.Address:

18.Place of birth: Home/CHAD/CMC/ Govt Hospital / PHC / Private hospital

19.Type of delivery: NVD/ Suction cup/ Forceps / Caesarean section

20.Gestational Age: wks days

21.Birth weight: kgs 22.Mother's education (total no. of yrs) :

23.Weight of child: kgs 24.Date of recording:

25.Age of child (months) at the time of recording: 26.Expected weight for that age : kgs

27.Total family income per month: 28.No. of persons in family:

29.Income per capita per month: 30.SES class:

CRITERIA	NOT AT RISK			AT RISK	
31.Mother's education	>5th grade			≤ 5th grade	
32.Socioeconomic status	Upper	Upper middle	Middle	Lower middle	Lower
33.Birth order	1	2	3	4 and above	
34.Death of either or both parents	No			Yes	
35.Mother working outside > 8 hrs / day	No			Yes	
36.Gestational Age	> 37 wks			≤ 37 wks	
37.History of death of 1 or more siblings less than 1 yr age	No			Yes	
38. Is this child one of twins?	No			Yes	
39.Birth weight	≥ 2.5kgs			< 2.5kgs	
40.Is the weight adequate for age?	Yes			No [Z score < (- 2SD)]	
41.History of 1 or more hospital admissions in the past 12 months	No			Yes	
42.Congenital heart disease	No			Yes	
43.History of CNS infection	No			Yes	
44.Seizure disorder	No			Yes	
45.Developmental delay	No			Yes	
46.Any major surgery	No			Yes	

ANNEXURE-3: Modified B G Prasad Scale

Modified BG Prasad scale (May 2016) – Vasudevan J et al ; International Journal of Research in Medical Sciences 2016 September: 4 (9)

Lower class →< ₹ 942

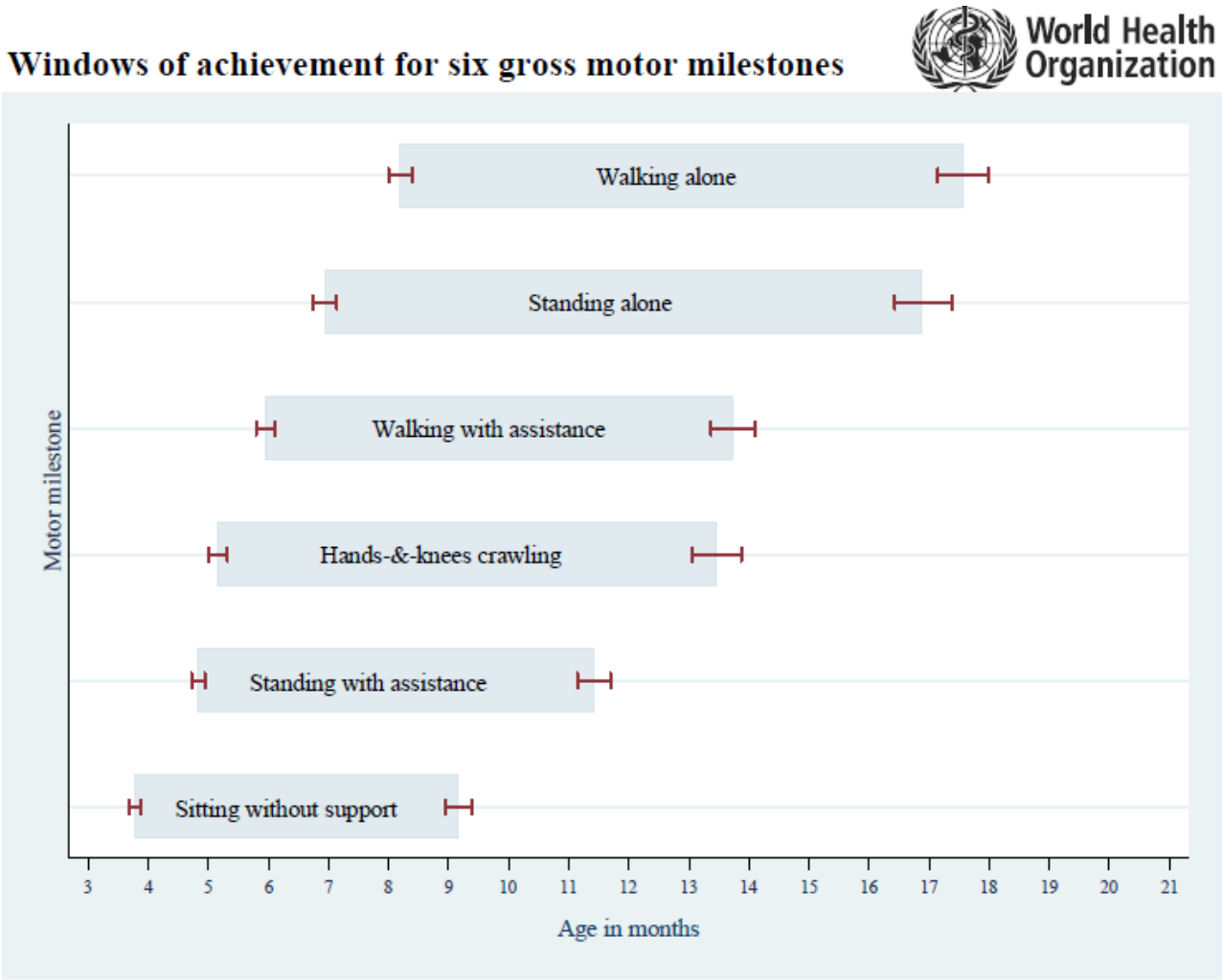
Lower middle class→ ₹ 942 to 1882

Middle class → ₹ 1883 to 3138

Upper middle class→ ₹ 3139 to 6276

Upper class → ≥ ₹ 6277

ANNEXURE-4: WHO Windows of Achievement for Six Gross Motor Milestones



Reference: WHO Multicentre Growth Reference Study Group. WHO Motor Development Study: Windows of achievement for six gross motor development milestones. Acta Paediatrica Supplement 2006;450:86-95.

ANNEXURE-5: WHO Weight – for – Age Z Scores (BOYS)

WHO Z-Scores WEIGHT FOR AGE CUT-OFF BOYS

Completed Age	Expected Weight (kgs)	Moderate/ Severe Malnutrition
0 Yr 0 Month	3.3	≤ 2.5
0 Yr 1 Month	4.5	≤ 3.4
0 Yr 2 Months	5.6	≤ 4.3
0 Yr 3 Months	6.4	≤ 5
0 Yr 4 Months	7	≤ 5.6
0 Yr 5 Months	7.5	≤ 6
0 Yr 6 Months	7.9	≤ 6.4
0 Yr 7 Months	8.3	≤ 6.7
0 Yr 8 Months	8.6	≤ 6.9
0 Yr 9 Months	8.9	≤ 7.1
0 Yr 10 Months	9.2	≤ 7.4
0 Yr 11 Months	9.4	≤ 7.6
1 Yr 0 Month	9.6	≤ 7.7
1 Yr 1 Month	9.9	≤ 7.9
1 Yr 2 Months	10.1	≤ 8.1
1 Yr 3 Months	10.3	≤ 8.3
1 Yr 4 Months	10.5	≤ 8.4
1 Yr 5 Months	10.7	≤ 8.6
1 Yr 6 Months	10.9	≤ 8.8
1 Yr 7 Months	11.1	≤ 8.9
1 Yr 8 Months	11.3	≤ 9.1
1 Yr 9 Months	11.5	≤ 9.2
1 Yr 10 Months	11.8	≤ 9.4
1 Yr 11 Months	12	≤ 9.5
2 Yr 0 Month	12.2	≤ 9.7
2 Yr 1 Month	12.4	≤ 9.8
2 Yr 2 Months	12.5	≤ 10
2 Yr 3 Months	12.7	≤ 10.1
2 Yr 4 Months	12.9	≤ 10.2
2 Yr 5 Months	13.1	≤ 10.4
2 Yr 6 Months	13.3	≤ 10.5

Completed Age	Expected Weight (kgs)	Moderate/ Severe Malnutrition
2 Yr 7 Months	13.5	≤ 10.7
2 Yr 8 Months	13.7	≤ 10.8
2 Yr 9 Months	13.8	≤ 10.9
2 Yr 10 Months	14	≤ 11
2 Yr 11 Months	14.2	≤ 11.2
3 Yr 0 Month	14.3	≤ 11.3
3 Yr 1 Month	14.5	≤ 11.4
3 Yr 2 Months	14.7	≤ 11.5
3 Yr 3 Months	14.8	≤ 11.6
3 Yr 4 Months	15	≤ 11.8
3 Yr 5 Months	15.2	≤ 11.9
3 Yr 6 Months	15.3	≤ 12
3 Yr 7 Months	15.5	≤ 12.1
3 Yr 8 Months	15.7	≤ 12.2
3 Yr 9 Months	15.8	≤ 12.4
3 Yr 10 Months	16	≤ 12.5
3 Yr 11 Months	16.2	≤ 12.6
4 Yr 0 Month	16.3	≤ 12.7
4 Yr 1 Month	16.5	≤ 12.8
4 Yr 2 Months	16.7	≤ 12.9
4 Yr 3 Months	16.8	≤ 13.1
4 Yr 4 Months	17	≤ 13.2
4 Yr 5 Months	17.2	≤ 13.3
4 Yr 6 Months	17.3	≤ 13.4
4 Yr 7 Months	17.5	≤ 13.5
4 Yr 8 Months	17.7	≤ 13.6
4 Yr 9 Months	17.8	≤ 13.7
4 Yr 10 Months	18	≤ 13.8
4 Yr 11 Months	18.2	≤ 14
5 Yr 0 Month	18.3	≤ 14.1

*WHO Growth Charts,WHO Global Database on Child Growth & Malnutrition

ANNEXURE-6: WHO Weight- for – Age Z Scores (GIRLS)

WHO Z-Scores WEIGHT FOR AGE CUT-OFF GIRLS

Completed Age	Expected Weight (kgs)	Moderate/ Severe Malnutrition
0 Yr 0 Month	3.2	≤ 2.4
0 Yr 1 Month	4.2	≤ 3.2
0 Yr 2 Months	5.1	≤ 3.9
0 Yr 3 Months	5.8	≤ 4.5
0 Yr 4 Months	6.4	≤ 5
0 Yr 5 Months	6.9	≤ 5.4
0 Yr 6 Months	7.3	≤ 5.7
0 Yr 7 Months	7.6	≤ 6
0 Yr 8 Months	7.9	≤ 6.3
0 Yr 9 Months	8.2	≤ 6.5
0 Yr 10 Months	8.5	≤ 6.7
0 Yr 11 Months	8.7	≤ 6.9
1 Yr 0 Month	8.9	≤ 7
1 Yr 1 Month	9.2	≤ 7.2
1 Yr 2 Months	9.4	≤ 7.4
1 Yr 3 Months	9.6	≤ 7.6
1 Yr 4 Months	9.8	≤ 7.7
1 Yr 5 Months	10	≤ 7.9
1 Yr 6 Months	10.2	≤ 8.1
1 Yr 7 Months	10.4	≤ 8.2
1 Yr 8 Months	10.6	≤ 8.4
1 Yr 9 Months	10.9	≤ 8.6
1 Yr 10 Months	11.1	≤ 8.7
1 Yr 11 Months	11.3	≤ 8.9
2 Yr 0 Month	11.5	≤ 9
2 Yr 1 Month	11.7	≤ 9.2
2 Yr 2 Months	11.9	≤ 9.4
2 Yr 3 Months	12.1	≤ 9.5
2 Yr 4 Months	12.3	≤ 9.7
2 Yr 5 Months	12.5	≤ 9.8
2 Yr 6 Months	12.7	≤ 10

Completed Age	Expected Weight (kgs)	Moderate/ Severe Malnutrition
2 Yr 7 Months	12.9	≤ 10.1
2 Yr 8 Months	13.1	≤ 10.3
2 Yr 9 Months	13.3	≤ 10.4
2 Yr 10 Months	13.5	≤ 10.5
2 Yr 11 Months	13.7	≤ 10.7
3 Yr 0 Month	13.9	≤ 10.8
3 Yr 1 Month	14	≤ 10.9
3 Yr 2 Months	14.2	≤ 11.1
3 Yr 3 Months	14.4	≤ 11.2
3 Yr 4 Months	14.6	≤ 11.3
3 Yr 5 Months	14.8	≤ 11.5
3 Yr 6 Months	15	≤ 11.6
3 Yr 7 Months	15.2	≤ 11.7
3 Yr 8 Months	15.3	≤ 11.8
3 Yr 9 Months	15.5	≤ 12
3 Yr 10 Months	15.7	≤ 12.1
3 Yr 11 Months	15.9	≤ 12.2
4 Yr 0 Month	16.1	≤ 12.3
4 Yr 1 Month	16.3	≤ 12.4
4 Yr 2 Months	16.4	≤ 12.6
4 Yr 3 Months	16.6	≤ 12.7
4 Yr 4 Months	16.8	≤ 12.8
4 Yr 5 Months	17	≤ 12.9
4 Yr 6 Months	17.2	≤ 13
4 Yr 7 Months	17.3	≤ 13.2
4 Yr 8 Months	17.5	≤ 13.3
4 Yr 9 Months	17.7	≤ 13.4
4 Yr 10 Months	17.9	≤ 13.5
4 Yr 11 Months	18	≤ 13.6
5 Yr 0 Month	18.2	≤ 13.7

*WHO Weight for Age Growth Charts, WHO Global Database on Child Growth & Malnutrition

ANNEXURE-7: Information Sheet (English)

Department of Community Health, Christian Medical College, Vellore

SCREENING FOR 'AT RISK' UNDER FIVE CHILDREN BY COMMUNITY HEALTH WORKERS- A STUDY IN A RURAL AREA OF TAMILNADU

INFORMATION SHEET

Aims of the study

The under five (0-5 yrs age) children constitute about 14% of the general population. The initial few years are quite crucial in life & the health status of the child & risk factors operating during this period are vital in determining future survival & quality of life. Certain factors have been identified over the years as high risk & the children exposed to these are widely termed as 'at risk'.

The Community Health Department of CMC Vellore (CHAD Hospital) is conducting a study to identify the children under the age of five years who are at higher risk of developing various diseases due to the various risk factors to which they are exposed to during their initial years of life. These include factors like low birth weight, introduction of foods other than breast milk to the baby before 6 months age , smaller age gap between the earlier/next child etc.

We will be identifying such children & collecting data regarding their health status in order to study the various health issues for which they are at risk for.

What is your role?

The study will be conducted from March 2016 to June 2017.If your child is in the age group of 0-5 yrs, we would collect these information to determine whether your child is at risk or not. If they happen to fall in the 'at risk' category, we would collect some basic data from you & your child like height, weight, feeding practices you follow, details regarding any treatments given for your child. No blood tests or any other painful procedures are required in this study.

What will I/my children gain from this study?

Information which you provide is highly useful for the field of public health & helps to design our health services so that issues which are important to you will be addressed more effectively. Health plans and programmes can be designed accordingly. This will provide better services to your children in future years.

Are there any risks for my child by getting involved in this study?

There are no risks for your child by getting involved in this study. There are no blood tests or any other painful procedures involved. No drugs would be administered. You are free to withdraw your child from the study at any point of time and it will not affect your/your child's further care in CHAD hospital.

Will the information which I provide be kept confidential?

The information which you provide will be kept confidential.

Whom to contact in case of any enquiry? [redacted] PG Registrar, Department of Community Health, CHAD Hospital, Bagayam , Vellore-632002 [redacted]

ANNEXURE-8: Information Sheet (Tamil)

ஐந்து வயதிற்கு உட்பட்ட 'ஆபத்தை எதிர்கொண்டுள்ள' குழந்தைகளை சுகாதார உதவியாளர்கள் கண்டறியும் முறை பற்றி தமிழ்நாட்டின் ஒரு கிராமப்புறத்தில் நடத்தப்படும் ஆய்வு

சமூக சுகாதாரத் துறை

கிருத்துவ மருத்துவ கல்லூரி – வேலூர்

தகவல் தாள்

ஆராய்ச்சியின் நோக்கம்

மக்கள் தொகையில் 14 சதவீதம் 5 வயதிற்குட்பட்ட குழந்தைகளாகும் (0–5 வயது). குழந்தையின் வாழ்வின் ஆரம்ப வருடங்களில் சில ஆண்டுகள் குழந்தையின் சுகாதார வாழ்வில் சிக்கலான தவிர்க்க முடியாத, குழந்தையின் எதிர்கால வாழ்வின் தரத்தை நிர்ணயிக்கும் காரணிகள் செயல்படும் காலமாகும். சில வருடங்களுக்கு பிறகு ஆபத்தை உருவாக்கும் காரணிகள் அடையாளம் காணப்பட்டு அவைகள் ஆபத்தை உருவாக்குபவை என அழைக்கப்படுகின்றன.

கிருஸ்துவ மருத்துவ கல்லூரி மற்றும் மருத்துவமனைகள் சுகாதாரத்துறை, வேலூர்

5 வயதிற்குட்பட்ட குழந்தைகளுக்கு பல்வேறு நோய்களை உருவாக்கும் காரணிகள் வளர்ந்து கொண்டிருக்கின்றன, எவைகள் குழந்தைகளுக்கு நோய்களை உருவாக்க குழந்தைகளின் ஆரம்ப கால வாழ்வின் சுகாதாரத்தை கெடுக்கும் காரணிகள் வெளிப்படுகின்றன. அவைகள் பிறக்கும்போது குறைவான எடை, 6 மாதத்திற்கு முன்பே தாய்ப்பால் கொடுப்பதற்கு பதிலாக உணவுகள் அறிமுகப்படுத்துதல், குறைவான வயது வித்தியாசம் அதாவது முந்தைய குழந்தைக்கும் பிறந்த குழந்தைக்கும் இடையிலான வித்தியாசம்.

நாங்கள் இவ்விதமான குழந்தைகளை அடையாளம் கண்டறிந்து அவர்களின் சுகாதாரப் பிரச்சினைகள் பற்றிய புள்ளி விவரங்கள் சேகரித்து அவர்களின் ஆபத்தான நிலையை ஆராய்வதற்து குழந்தைகள் கண்டறிவோம்.

உங்களின் பங்கு என்ன ?

இந்த ஆராய்ச்சி மார்ச் 2016 முதல் ஜூன் 2017 வரையிலானது. தங்களின் குழந்தை 0 – முதல் 5 வயதிற்குட்பட்டதெனில் இத்தகைய விவரங்கள சேகரிப்போம். அதன் மூலம் தங்கள் குழந்தை ஆபத்தான நிலையை உடையதா இல்லையா என தீர்மானிப்போம். அப்படி ஆபத்தான நிலையை உடையதாக இருப்பின், குழந்தையின் அடிப்படையான விவரங்களை அதாவது குழந்தையின் உயரம், எடை, நீங்கள் பின்பற்றும் உணவு பழக்க வழக்கங்கள், குழந்தைக்கு கொடுக்கப்பட்ட சிகிச்சைப் பற்றிய விவரங்கள், இரத்த பரிசோதனை அல்லது வலி நிறைந்த முறைகளோ இருக்காது.

இந்த ஆராய்ச்சி மூலம் நான் மற்றும் குழந்தை பெறும் பலன் என்ன ?

தாங்கள் தரும் தகவல்கள் பொது சுகாதாராத்திற்கு மற்றும் சுகாதாரச் சேவைகளை திட்டமிட மற்றும் நீங்கள் தெளிவாக புரிந்து பேச பயன்படும். இதற்கு ஏற்றார் போன்று சுகாதார திட்டங்கள் திட்டமிட்ட பயன்படும். உங்களின் குழந்தைக்கு எதிர்காலத்தில் மிகச் சிறந்த சேவையை வழங்கும்.

இந்த ஆராய்ச்சியின் என் குழந்தை பங்கு பெறுவதால் ஏதேனும் ஆபத்து உள்ளதா ?

உங்கள் குழந்தை இந்த ஆராய்ச்சியில் பங்கு பெறுவதால் எந்த ஆபத்தும் இல்லை, இரத்த பரிசோதனை மற்றும் வலி நிறைந்த செயல் முறைகளோ இல்லை. மாத்திரைகள் ஏதும் தரப்படமாட்டது. இந்த ஆய்வில் எந்த கட்டத்திலும் தங்கள் குழந்தையை விடுவித்துக்கொள்ளமுடியும். மேலும் அது தாங்கள் 'சாட்' மருத்துவமனையில் பெற்றுவரும் வைத்தியத்தை பாதிக்காது.

மேலும் விவரங்களுக்கு யாரை தொடர்பு கொள்வது ?

டாக்டர் [redacted] முதுகலை பதிவாளர், சமூக சுகாதாரத் துறை, CHAD மருத்துவமனை, பாகாயம், வேலூர் – 632002. தொலைபேசி [redacted]

ANNEXURE-9: Informed Consent Form (English)

Department of Community Health, Christian Medical College, Vellore

SCREENING FOR 'AT RISK' UNDER FIVE CHILDREN BY COMMUNITY HEALTH WORKERS- A STUDY IN A RURAL AREA OF TAMILNADU

INFORMED CONSENT FORM

Sample ID No:

Name of Subject: Date of birth/Age:

Informant: Relationship with subject:

(i) I confirm that I have read and understood the information sheet dated _____ for the above study and have had the opportunity to ask questions. [ ]

(ii) I understand that my child's participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. [ ]

(iii) I understand that the department of Community Health, the Ethics Committee and the regulatory authorities will not need my permission to look at my child's health records both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the trial. I agree to this access. However, I understand that my child's identity will not be revealed in any information released to third parties or published. [ ]

(iv) I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s). [ ]

(v) I agree to take part in the above study. [ ]

Signature (or Thumb impression) of the Subject/Legally Acceptable

Date: _____/_____/_____

Department of Community Health, Christian Medical College, Vellore

Signatory's Name: _____ Signature:

Or

Representative: _____

Date: _____/_____/_____

Signatory's Name: _____

ANNEXURE-10: Informed Consent Form (Tamil)

சமூ:க சுகாதாரத; துறை.

கயீருத;துவ மருத;துவ கல;லுனூாயீ ? வேலுனூா;

ஐந்து வயதிற்கு உட்பட்ட 'ஆபத்தை எதிர்கொண்டுள்ள' குழந்தைகளை சுகாதார உதவியாளர்கள் கண்டறியும் முறை பற்றி தமிழ்நாட்டின் ஒரு கிராமப்புரத்தில் நடத்தப்படும் ஆய்வு

ஒப;பஸதல; வழ';கும; படிவம;

மாதயீாயீ அடையாள எண; :

குழந;தையயீன; பெயா; **குழந;தை பயீறந;த தேதயீ – வயது:**

தகவல; தருபவா; :

குழந;தைக;கு என;ன உறவஸ முறை :

மேற;குறயீப;பயீட;ட ஆராய;ச;சயீ பற;றயீய தகவல; அட';கயீய படிவத;தை (தேதயீயயீட;ட) படித;து பஸாயீந;துகொண;டேன;/ மேலும; கேள;வயீ கேட;கும; வாய;ப;பஸம; ,ருந;தது என;பதை உறுதயீ செய;கயீறேன;/

1) என; குழந;தையயீன; ப';கேற;பஸ தன;னயீச;சையானது மேலும; ,ந;த ஆராய;ச;சயீயயீன; எந;த நயீலையயீலும; வயீலக. எந;த காரணத;தையஸம; கூறாமலும;. என; மருத;துவ சலுகை மற;றும; சட;ட;ப;படியான உாயீமை பாதயீக;காத வண;ணம; எனக;கு வயீலக உாயீமை உண;டு என பஸாயீந;து கொண;டேன;/

2) சமூ:கசுகாதார த;துறை. அறயீவயீயல; ஆய;வஸக;குழு மற;றும; ஒழு';குமுறை குழு என; குழந;தையயீன; சுகாதார;ப; பதயீவேடு. மேற;கொண;டு நட த;தும; ஆராய;ச;சயீக;காக மேலும; நான; வயீலகயீனாலும; என; அனுமதயீ தேவையயீல;லை/ மேலும; என;

குழந;தையயீன; அடையாளம; மற;றும; தகவல;கள; மு:ன;றாம; நபா; அல;லது வெளயீய;ஞடாக வெளயீட;படுத;த மாட; ட;கள; என;பதை ஒத;துக;கொள;கயீறேன;/

3) ,ந;த ஆராய;ச;சயீ மு:லம; கயீடைக;கும; பஸள;ளயீ வயீவர்';களை பயன;படுத;த எந;த தடையஸமயீல;லை. .து முழுக;க அறயீவயீயல; நோக;கத;தயீற;காக மட;டுமே;/

4) ,ந;த ஆராய;ச;சயீயயீல; ப்';கேற;க ஒட;பஸக;கொள;கயீறேன;/

கையெழுத;து (கையொட;பம;) பெற;றோா; –

சட;ட;படி ஒப;பஸக;கொள;ளக; கூடியவா;

கையெழுத;து : **(அ)**

தேதயீ :

கையெழுத;தயீடுபவாயீன; பெயா;:

கையெழுத;து : **(அ)**

தேதயீ :

பெருவயீரல; ரேகை

பயீரதயீநயீதயீ :

தேதயீ :